January 1955

Agriculture

The Journal of the Ministry of Agriculture

January morning

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HER MAJESTY'S STATIONERY OFFICE

Oil speeds the plough

THERE WAS a ploughing match in England last October, and one of the competitors was a woman. She was doing good time and straight furrows till, ten yards short of the finishing post, her tractor stalled. It had run out of fuel. She was disqualified. She took it hard, insisting that her fuel had been siphoned down by a rival. The sad story made front page news in the papers.

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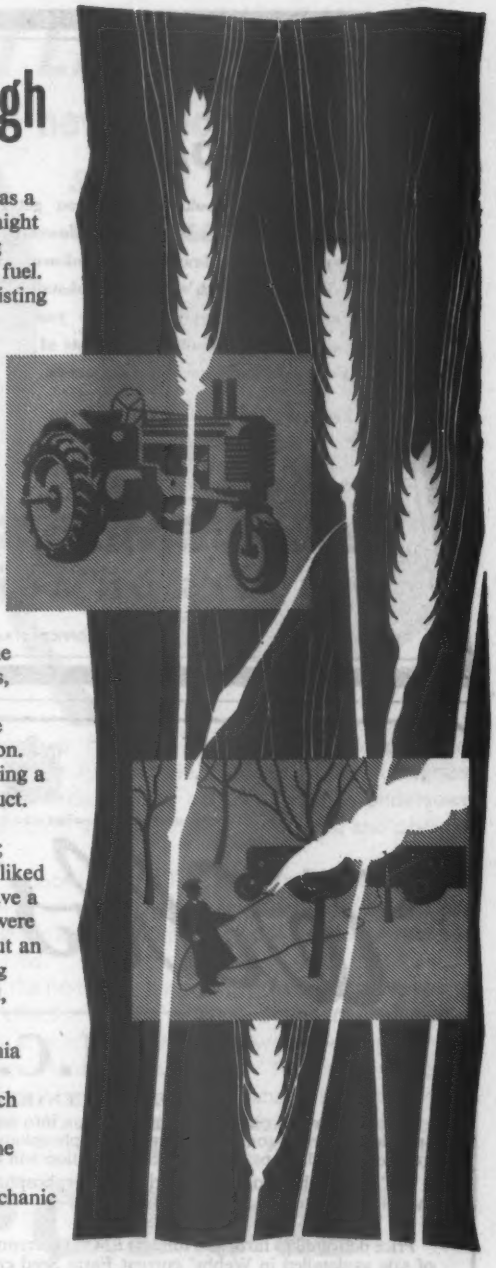

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AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

Editorial Offices: 3 Whitehall Place, S.W.1 (*Phone: TRAfalgar 7711*)

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AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

VOL. LXI No. 10 JANUARY 1955

FOWL PEST

JOHN REID, M.R.C.V.S., D.V.S.M.

Ministry of Agriculture and Fisheries

Fowl pest has caused serious losses to our poultry industry since it reappeared in Great Britain in 1947. But there are encouraging signs that, given the full co-operation of poultry-keepers, the present policy will eventually lead to complete eradication.

THE term fowl pest includes two of the major serious diseases of poultry—Newcastle disease and fowl plague. The disease which has been present in this country for the past seven years is Newcastle disease, and it is therefore proposed to deal only with that disease in this article. The first accurate description of Newcastle disease came from a research worker in the Dutch East Indies in 1926, and although he reported that it was killing enormous numbers of poultry, he was unable to find the cause. In the same year Doyle carried out an investigation into an outbreak of a disease of a particularly virulent nature among poultry near Newcastle-on-Tyne. He described it fully, identified the virus which caused it, and gave the condition the name by which it is now generally known.

In the next year there were other outbreaks in England, but, subsequently, the disease apparently died out. No doubt its arrest was greatly assisted by the fact that when it struck a flock of poultry the mortality was very high —sometimes 100 per cent. The food of the birds in the Newcastle outbreak included offal collected at the seaport town, and it was thought likely that the disease had been introduced by infected food refuse from a ship. Meanwhile, Newcastle disease was being recorded in different countries in the Far East. Between 1926 and the early 1930s it appeared in India, the Philippines, Malay States, Korea, Japan and Australia. It seems that it reached Europe just before the war, and during the war years it spread rapidly, until it had been identified in domestic poultry in almost every country in Europe. England had had a second "strike" in 1933, when one outbreak was confirmed and the virus was identified by Dobson. The mortality rate was high and the owner voluntarily slaughtered the survivors, but there was no spread to poultry on other farms. Then in 1946 it was stated that a disease known as pneumoencephalitis, which had been known for several years in the U.S.A., was found to be caused by a virus which had immunological properties identical with the Newcastle disease virus. Affected fowls showed respiratory and nervous symptoms generally of a much milder nature than had been experienced in Europe and elsewhere.

Thus in a quarter of a century after being first identified Newcastle disease was present in every continent and menacing the poultry flocks of almost every country.

The Acute Form Reappears in Britain In Great Britain the third "strike" came in February 1947, when the disease was introduced with poultry carcasses from Central Europe. This virus was particularly virulent. By the end of the year, 2,222 outbreaks had been confirmed—mostly in small flocks belonging to domestic poultry-keepers, who were supplementing their war-time poultry rations with waste food. The fact that carcasses imported from Europe were infected was confirmed by the recovery of the virus of Newcastle disease from the carcasses of all classes of poultry at the Ministry's Laboratory at Weybridge.

Legislation to deal with fowl pest had been available since 1936. At that time an Order, entitled the Fowl Pest Order, had been made following an extension of the scope of the Diseases of Animals Acts to include poultry. This Order merely gave power to control infected premises and to slaughter infected and contact birds, with compensation for the latter, and in past experience this would have been adequate. However, it was found necessary to make the disease notifiable, and this was done in 1947. In view of the obvious origin of outbreaks from swill, a further precaution was taken to extend the requirements for boiling waste food to include that fed to poultry. In addition, arrangements were made for the evisceration of all poultry carcasses imported from Europe. This was simple, because at that time the Ministry of Food was the sole importer. Arrangements were made later for the distribution of imported carcasses to five mainly urban areas, where it was known that the poultry population was comparatively low and where it was thought that if outbreaks did occur they could be confined. The landing in Great Britain of live poultry and hatching eggs, with few stated exceptions, had already been prohibited.

This was a spectacular disease with unmistakable symptoms. The birds became listless, lost their appetite, had a copious greenish-yellow diarrhoea, showed great respiratory distress, and often had signs of nervous derangement. The illness generally lasted 24-48 hours. The mortality rate was high and, within the flock, the disease was very contagious. In some instances the whole flock succumbed.

In the late autumn and winter of 1947 infection was spread by dealers and through markets, and thus the disease soon became widespread. A ban on the movement into Scotland and northern England of live poultry from the rest of England and Wales was imposed in August 1947, and this measure was effective. By the summer of 1948 the epidemic was on the wane, but in 1949 there was again an increase in the number of cases. In September Scotland became involved in a serious flare-up of disease, after having been free, except for an uncomplicated outbreak resulting from an illegal movement of live poultry in Midlothian in 1948. The disease appeared first in Orkney, and outbreaks occurred in several islands in Orkney, Shetland and the Hebrides: infection also reached the Bass Rock in the Firth of Forth, and coastal areas in the counties of Argyll, Wigtown and Aberdeen. At the same time, fowl pest was confirmed in Northern Ireland. The epidemic in Scotland reached its peak in October 1949, and lasted twelve months, with a total of 203 outbreaks.

The distribution of these outbreaks suggested the possibility that sea birds, although themselves apparently healthy, were infective and capable of conveying disease to more highly susceptible domestic fowls. It is possible that infective material discharged from ships had been carried ashore by scavenging seagulls, or that dead fowls dumped in the sea following many of the outbreaks had provided a source of infection. However, it

became clear that sea birds were more than mechanical carriers of disease, for the Ministry's laboratories recovered virus from shags, cormorants and gannets, although none of these birds showed any symptoms of disease. There is strong evidence from ornithologists that these species of sea birds will not scavenge for food, but are exclusively fish-eaters. Further work on this interesting subject is being continued.

Notwithstanding the fact that there were still outbreaks of the disease in the areas of distribution of imported carcasses and in the vicinity of ports, where swill was incriminated, it could be said up to the autumn of 1950 that the slaughter policy, with restriction on movements and scrupulous disinfection of infected premises, had been successful. The records show that the great majority of cases was reported, and a high proportion of negative incidents was also dealt with. Even in instances where the mortality was less striking, owners were alive to their responsibility.

Difficulties in Recognizing the Mild Forms There had always been a possibility that the virus which caused the acute symptoms would be replaced by the North American type. Although immunologically identical with the Asiatic type, its milder form had delayed recognition of the disease in the U.S.A. until it had gained at least ten years' hold on the industry. The Ministry's veterinary advisers were aware of this possibility following an experience of 1948, when fowls in a laying trial had given results to a blood test which could only have arisen from contact with Newcastle disease virus. These birds had no history of illness, nor had other birds in the trial which had also given positive blood tests. The only history at the source from which these birds had come was that different batches of young chicks had shown signs of coryza at ages varying up to a month. It seemed, therefore, that there had been a low-grade brooder infection and that the chicks recovered quickly with no clinical effects. Some adult fowls gave positive results when tested, but there was no record of any illness in these. A limited survey by blood test was undertaken in similar premises and it failed to reveal any evidence of that infection. It was concluded, therefore, that this "low" form of disease was not widely prevalent.

By October 5, 1950, there had been a five-week period in which no case of Newcastle disease had been confirmed in Great Britain. On that date, however, an outbreak was confirmed at Mildenhall, West Suffolk, and this incident, because of the extensive movement of birds by dealers and through poultry markets, gave rise to a large number of outbreaks, mainly in East Anglia. This was the first occasion in any series of outbreaks in which the symptoms presented were consistently sub-acute. Poultry-owners were warned of this new form of illness, which appeared to be highly infectious. The most notable symptoms were a sudden drop in egg yield, often accompanied by respiratory distress and coryza of varying degrees. There was a low mortality in adults, although infected groups of young birds had a case mortality rate of up to 40 per cent.

Thus the industry was exposed to a disease which often was no more spectacular than other less serious respiratory troubles, and there was consequently an understandable delay in reporting suspected cases. It was no longer possible from the symptoms disclosed to establish a diagnosis of fowl pest beyond doubt in all instances. The haemaglutination inhibition test now came to be widely used to confirm that the symptoms were indeed associated with Newcastle disease virus. In this first series of outbreaks 63 cases were dealt with, but by December outbreaks had also occurred in

other parts of England and among fowls which had been exhibited at the National Poultry Show. All birds moved from this show were accordingly traced—an exercise which, by January 1951, disclosed 251 outbreaks in England and Wales and four in Scotland.

The wide publicity about fowl pest resulted in excellent co-operation from owners, and the epidemic, which otherwise might well have become extremely serious, was brought under control during the early part of 1951. By April of that year, only 18 cases were confirmed. Another important improvement in the outlook was the prohibition of the importation of poultry carcasses from any countries in which the disease was endemic.

The proximity of the U.S.A. Air Force Camp at Mildenhall suggested the possibility that the original infection in Suffolk originated from swill, because it was known that the camp rations included carcasses from the U.S.A., where the sub-acute form of the disease is endemic. This evidence is to some extent offset by the fact that this form of the disease had also appeared in Europe.

Improvement in the position was maintained until the autumn of 1952, when the disease reached a large rearing establishment attached to a hatchery and was disseminated widely by sales of young birds. Similar incidents occurred in 1953 and 1954, and the situation in Lancashire, where there is a very high poultry population, justified the imposition of special restrictions on movements of poultry in a defined area of the county and the prohibition of any movement of live poultry out of the area.

Encouraging Progress It is quite clear that measures embraced in the Fowl Pest Orders, together with area restrictions on movements, have dealt adequately with the per-acute form of disease—there were only seven cases in 1953 and none up to the middle of 1954. It is equally plain that Newcastle disease in its sub-acute form smoulders in some parts of the country, but there is no reason to believe that there is widespread undisclosed latent infection. This is supported by the results of a blood test survey carried out in 1953 in counties where infection might well have been expected. About 10 per cent of over half a million birds in all classes of flocks on nearly 3,000 holdings were sampled. The results were submitted to a committee of representatives of all branches of the industry, and a statement was issued which agreed that "on this evidence the overall position is considered to be encouraging. The Ministry remains of the opinion that given the continued full co-operation of the poultry industry, there is a reasonable prospect of the disease being eradicated".

Legislation exists applicable to England and Wales to control markets by licensing to ensure that store and fat poultry are not sold in the same market, and that the latter class of birds is slaughtered immediately after sale. All licensed sales are conducted by auction, so that records can be kept to facilitate the tracing of stock. Day-old chicks may not be exposed in markets. No poultry may be moved off a holding if any other poultry have been moved on to it in the previous 28 days—a precaution which has been a great factor in limiting disease to the infected flock. There is also legislation applicable to Great Britain which prohibits the exposure of sick birds in markets or in transit and also ensures proper cleansing and disinfection of poultry crates and receptacles. There is no doubt, however, that some of these preventive measures are sometimes not fully complied with by the poultry trade,

The Clean Area Plan In 1954 restrictions on movements of birds were made more stringent. Following the experience in Scotland, where movement of poultry, day-old chicks and hatching eggs from any other part of Great Britain is prohibited, and in which there has been no outbreak of fowl pest since September 1951, it was decided to apply similar restrictions to an area comprising the whole of Wales and the administrative counties of Chester, Derby, Salop, Stafford, Hereford, Warwick and Worcester. That area was declared to be clean country, into which no poultry (except day-old chicks and hatching eggs) might be moved from any other part of Great Britain. In this defined area the number of outbreaks of the disease in the last few years has been negligible, compared with the position in other parts of England. The main purpose of this restriction is to prevent secondary outbreaks arising from the movement of birds. Potentially, any of these might lead to the establishment of infection and serious spread in otherwise clean country. To the end of September 1954, 602 cases have occurred in England and Wales, and only 11 of these have been in the clean area. This gives confidence to recommend extension of the clean area principle.

Having provided safeguards against the introduction of disease to comparatively clean areas, all possible effort can be directed to control and eradication in the counties where disease continues to appear. Here, special movement control can be applied where necessary to prevent spread from heavily infected areas. While it cannot be claimed that the slaughter policy in the kind of disease encountered now can be quickly successful, as it is with, say, foot-and-mouth disease, the Ministry's records for 1954 show that Newcastle disease, even in its sub-acute form, can reasonably be suspected by careful owners. Owners can do much to help the authorities here: any suspicion, no matter how slight, should be notified. Of the total of 602 outbreaks to the end of September 1954, 158 were "primary" cases and, of these, 135 were reported by owners. From these primary outbreaks, 444 outbreaks resulted from mainly local spread, direct sales, dealers' transactions, and sales through markets. The control of poultry movements is more difficult than that of other farm livestock; dealers are involved to a greater extent; records of movement are not so well kept; and the tracing of poultry can never be accurate because of the impossibility of definite identification.

Alternatives to Slaughter It has been suggested that sub-acute fowl pest is no more serious than some other ills to which the industry is exposed—for example, coryza—and that all that is needed is quarantine of the infected flock. This is an unrealistic attitude. The loss in egg production as a result of Newcastle disease is very considerable, no matter how low the mortality rate may be in the flock. There is great delay in birds regaining full production, and even then a high proportion of shell-less and misshapen eggs are produced. The disease is highly infectious and will spread rapidly through a flock, with a case mortality of up to 50 per cent in growing birds. In the early incubative stage the virus is transmitted in the egg, and will kill the developing embryo, so hatchability is reduced. Fowl pest does not respond to any medicinal treatment. It is known that the presence of the virus in a flock lowers resistance to other infections which, if uncomplicated, are amenable to treatment. In the aggregate, these are crippling losses to an owner. And quarantine of the flock would have to be applied for a long period—until recovery took place in the last bird affected.

Another alternative suggested is vaccination. But immunization, as practised elsewhere, is in most cases a method enforced by circumstances and not by choice as an alternative where, because of widespread infection, a slaughter policy is not a practicable proposition. In some countries it is readily accepted that immunization is part of a campaign in which eradication is the final goal.

Efficient vaccines, inasmuch as they can now be administered by simple methods, have been prepared, but immunity with the best of vaccines is not of long duration. A matter of a few months' protection is all that can be expected of them, and while this might provide adequate cover for birds that are being quickly fleshed in the large-scale production of table poultry, the procedure would be much more complicated in breeding flocks, in which repeated vaccination would have to be carried out. There is also a growing impression that other diseases which are latent in poultry stocks may become a real problem when birds are vaccinated against fowl pest. The cost, too, would be a considerable financial burden on the industry. It would no longer be possible to employ the H.I. blood test to confirm diagnosis, since the test would be positive in immunized birds. Nor would vaccination relieve us of movement restrictions. Since it would be unreasonable to immunize flocks in areas which are relatively clean, vaccination would have to be limited to other areas, and the same pattern of movement restrictions would be inevitable.

Eradication the Goal Although it is disappointing that fowl pest is still a great hazard to poultry-keepers in some parts of England, there is irrefutable evidence that it is limited to certain counties in which it can be contained by the present methods. The responsibility of flock owners in the control of this disease is greater than it is for stock owners in other notifiable diseases now under control. There is every sign, however, of full co-operation from them, and it is for this reason that we can confidently pursue the present methods, with eradication as our ultimate aim.

Agricultural Research at Sittingbourne

All the agricultural research work carried out by the Shell Group in their laboratories at Amsterdam and Thornton, Cheshire, is to be transferred to the Shell Agricultural Research Centre at Woodstock Farm, near Sittingbourne, Kent, where extensions to facilities at present in progress will cost £150,000. When these are complete, chemical synthesis and analysis will be done on the spot, so saving a good deal of time in relation to seasonal urgency.

The new buildings will comprise three new laboratories, increasing laboratory space fivefold from the present 4,000 square feet to 21,000 square feet, an administration block which will include a new conference room and library, a new engineering workshop, and two additional glasshouses. The present staff of 32 will be increased to nearly 100.

Despite its technical and scientific background, Woodstock, which was bought by Shell in 1945, is run as a farm, and of its 254 acres 170 are cropped for the production of cereals, hops and fruit. The requirements of research have priority in the farming plan, but, thereafter, the farm operates as far as possible on normal commercial lines.

EARLY BEEF

S. BREWIS
Belford, Northumberland

The right stock and good rearing are two essentials in the production of early beef. Given the right type of store animal, the feeder can meet the consumer's demand for good quality joints.

THERE is no doubt that at the present time the need for early beef is more essential than ever before, and for more reasons than one, and also in more senses of the word "early" than one. Let us take a look and see what is happening in the beef markets today. There is a great cry for lean meat. I emphasize the word "meat", for in this craze for meat without fat, to use the word "beef" would be to insult what we have customarily thought of as "the Roast Beef of Old England". Fifty per cent of the cattle killed this autumn have not been beef in the true sense of the word, but have been slaughtered to satisfy this craze. It is the good store cattle that should be going to the feeders that are most in demand for slaughter today. This being so, where is the feeder's raw material for the production of next spring and summer's supply of beef to come from, except from the younger cattle which will have to be slaughtered at least at an early age, even if they are not beef at that age?

As I see the picture, since decontrol we have slaughtered the potential supply of beef stores for this winter's feeding and early beef next summer, and I am sure that all feeders will regret that this has happened.

The first point I would stress, therefore, is that if we are to produce good early beef rather than half-finished stores, it is absolutely essential to have the right stock. As a feeder, let me say right away that whatever may be possible in theory, in practice, good quality early beef cannot be other than divorced from dairying. The objectives of the two are poles apart. Whereas the milk producer naturally aims at selling as much milk as possible off the farm, early beef cannot be produced without milk, and plenty of it, in the early stages of the animal's life.

In this country we have many breeds and crosses suitable for the production of early beef, and these vary in the different parts of the country according to local conditions. I will confine myself, therefore, to those which are typical of the Borders and that part of the country where I farm and where, in my view, some of the best cattle for this purpose are bred and reared.

The Choice before Us As I know them, the Aberdeen-Angus, the Beef Shorthorn and the Hereford, together with their crosses, are the most suitable for early beef. Frequently the Angus bull is mated to the pure Beef Shorthorn or the pure Hereford cow. The crosses most commonly used, however, are those obtained by mating the Aberdeen-Angus bull to a first-cross Aberdeen-Angus/Shorthorn cow and the Aberdeen-Angus/Hereford cow. The animals so produced are ideal for early beef. Most of them are single-suckled and leave their mothers in October with a great wealth of flesh, having been reared on moderate and semi-marginal land to land bordering on feeding quality. They are in great demand at the suckler calf sales held at St. Boswells, Reston, and other centres, either for finishing inside at about 7-9 cwt. at round about 15-18 months of age, or for growing on to finish off the grass during the next summer at, say, 9-11 cwt. In either case, they are the best beef that money can buy.

Now whether we can afford this luxury beef at the present time is a debatable point. With the present shortage of good beef stores, if we are to kill these well-bred cattle at such an early age we are going to have to rear quite double the quantity each year to satisfy the demand for beef. I would suggest, too, that if this is the class of beef which the consuming public wants, they must be prepared to pay at least 25 per cent more for this quality, than for the beef of the heavier and more mature animal which is grown on to 2½-3 years old and weighs then, say, 11-13 cwt., according to sex. For instance, suckled calves this autumn were making around £8-9 per cwt., and the cost of winter feeding is relatively expensive. In addition, from the feeder's point of view, cattle that don't grow into weight can never be any use financially. With prices as they are today, the feeder is paying at least as much, and often more, per cwt. for good stores as he is getting for the finished beast. Especially is this so in the spring, when grass is growing and the demand is greatest, and it should be remembered that many of the cattle bought then meet the autumn trade, when fat prices are at their lowest. The trouble at the moment is that once an animal is on the butcher's shelf in the form of joints, there is no way for the inexperienced to distinguish between beef of various qualities, although of course, as with the proverbial "pudding", the proof is in the eating.

Apart from the shortage of animals of a suitable type and the extra cost involved in producing the kind of early beef I have described, there is the physical limit imposed by the necessity of making full use of the large areas of the poorer marginal and hill land for the production of beef stores. This type of land is not good enough for carrying the early-maturing breeds and crosses such as I have mentioned, which, with the right treatment, are in my view the foundation of early beef. We therefore have to depend on the hardier breeds and their crosses for the stocking of this land, and in this part of the country the most suitable are the Galloway and the Highland.

These breeds and their crosses are ideal for the Border Hills. The Galloway cow is mated to the White Beef Shorthorn bull to produce the Blue Grey, which is noted for its beef qualities and its hardiness. The Highland cow mated with the Beef Shorthorn produces an animal very similar to the Blue Grey. These cattle are by no means slow feeders and, given the same chance as the Aberdeen-Angus/Shorthorn and Hereford crosses, could still be a source of early beef, although not quite so early as the latter. Alternatively, the females from the hardier first crosses just mentioned are ideal for crossing again with bulls of an early-maturing beef breed, and the produce of these second crosses will mature more quickly than the first crosses. In fact, these potential beef stores are the feeder's ideal cattle for finishing at, say, 2½-3 years old, which, considering the land they have been bred and reared on, is in my opinion a reasonably early age.

Good Rearing Essential With regard to feeding for early beef, the method of rearing the calf very largely determines the age at which the animal will be ready for the butcher. There is obviously a place for multiple suckling and pail feeding as well as single suckling, but it is just as obvious that a pail-fed calf, usually given a minimum amount of milk, will not be finished beef so early as one single-suckled. It is therefore necessary to decide at the very beginning what one is aiming at and to adjust the feed to give that rate of progress which will bring the animal to the finished stage at the required age. Remember that for early beef, a calf must be well reared in addition to being well bred. At no time in its life should it be allowed to have a set-back; once this has happened, the

calf is never the same again, either in its life or in carcass form. The flesh is never as even or the marbling so good as in one that has not had a check. In my opinion, the single-suckled calf, especially the heifer, carried on straight off its mother at, say, eight to nine months, is the right subject for making early beef at 15-18 months. Given the right accommodation and suitable foods, these calves will make the maximum weight gain that it is possible to attain in that time. I don't propose to go into the subject of rations, but I will say that whatever roughages are fed should be of high quality; good hay, a few fingered swedes, and 4 or 5 lb. of crushed oats and beans take a lot of beating. The steers, I am convinced, are better for a longer finishing period, with a less concentrated diet to start with, but kept in a thriving and growing condition throughout. Finishing at, say, 24-27 months at 11-12½ cwt., they make the more serviceable beef of the two.

The hardier breeds and their crosses previously mentioned, allowed to grow naturally, with suitable accommodation for wintering and suitable foods throughout their store period on the higher grazings, are ideal stores for the feeder, either for yards or grass feeding, and at the present time are making quite £1 per cwt. more than the average price of good beef. These cattle finished at 2½-3 years are still, in my opinion, early beef, and they will have served a very useful purpose during their lifetime, in converting a good deal of the by-product roughages from arable cash crops into beef.

The Ideal Animal The feeder's raw material is the store beast, and in conclusion may I outline the type of animal which I consider ideal for the production of high-quality early beef. A beef beast should be wide, compact, deep and rectangular. It should be low set with uniform depth, a straight top and straight underline, full fore and rear flank, full thighs and twist; it should have good straight legs—one at every corner and be able to walk on them. Width is a "must", especially over the top, with ribs deep and well sprung from the back, giving plenty of heart room and leaving no deficiency behind the shoulder. The width should carry back from the shoulders over well-filled crops, back over a reasonably short well-fleshed back, to a wide deep loin. The hooks should be well buried, the rump or plates should be long and level carrying back to wide-set pin bones. The tail should be set "in" and not "on", and should fall down between the thighs at right-angles to the body. If we are to build up an expanding market for good quality British beef, we simply must have more well-reared stores of this type, and as a feeder I would say "Give us the stores (at the right price!) and we'll finish the job".

SILAGE FOR BEEF AND MILK PRODUCTION

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Feeding trials last winter at the Cheshire School of Agriculture with fattening steers and dairy cows confirm earlier findings on the high value of silage as a winter feed.

FURTHER silage-feeding trials were carried out at the Cheshire School of Agriculture, Reaseheath, during the winter of 1953-54 as a sequel to those undertaken the previous winter and reported in this JOURNAL in December 1953 (1). The objects of those trials were: (1) to collect information on the performance of both dairy cows and growing and fattening bullocks when fed heavy silage rations; (2) to assess the feeding value of the silage in terms of starch equivalent (S.E.) and protein equivalent (P.E.) from the performance of the animals; and (3) to compare the values so obtained with those expected from the chemical analysis of the silage.

The previous trials (in 1952-53) had shown that well-made silage gave very satisfactory results in terms of liveweight gain and milk production, but whilst in the case of the growing animals the derived S.E. (that is, from performance) of the silage agreed very well with the figure expected from analysis, the derived figure for the dairy cows was about 15 per cent below the expected value. It was realized that the method of assessing feeding value from performance is subject to many errors, but it was felt that if precautions were taken to reduce these errors, then the results should be of value in practice.

We were fortunate in that for the 1953-54 trials we were able to use the same four steers—now nearly two years old—as in our previous work and, with one exception, the same group of dairy cows.

The variety of foods used in the trial was kept to a minimum, consisting of silage, ground oats and dairy cake only. To form an accurate estimate of the nutrient intake, all foods were carefully weighed and repeatedly sampled and analysed. The following feeding values for the oats and dairy cake were calculated from the analytical figures:

	Estimated S.E.	Estimated P.E.
Purchased dairy cake	72.1	18.1
Ground oats	61.7	8.9

The silage fed to both experimental groups was taken from the same pit. It was made from leafy grass and clover and was well fermented, but rather wet. The silage was also sampled and analysed frequently, the average results being:

	Dry Matter *per cent*	*p*H	Crude Protein *per cent of D.M.*	Crude Fibre *per cent of D.M.*
Silage fed to steers	17.5	4.4	16.6	32.4
Silage fed to dairy cows ...	17.9	4.3	16.3	32.3

This silage was considered rich enough in protein for milk production, and a ration was designed so that the silage provided for the first two gallons of milk.

A Good Fattening Diet The four animals used in the fattening trial were dehorned pedigree Dairy Shorthorn steers just under two years old at the start of the trial, which lasted from December 1, 1953 to April 27, 1954—approximately five months. During the previous winter these animals had been fed mainly on silage, and they had been out at grass during the summer. They were brought into an open yard in late autumn with the object of being finished for beef on a ration again consisting mostly of silage. After a preliminary feeding period the animals were given the following daily ration:

December 1–January 21 ... ... Grass silage to appetite
January 22–April 27 ... ... 5 lb. oats, plus grass silage to appetite

A record was kept of all the silage fed during the trial, and it was found that over the period each animal consumed about 5 tons 6 cwt.—an average of 80 lb. per head per day. After the introduction of the oats, the average daily consumption of silage dropped from 95 lb. to 74 lb. The beasts were weighed regularly and gained weight rather erratically at first, but steadily during the last three months.

The average daily liveweight gain over the trial period was 1.80 lb. (see Table 1), and taking the accepted standards for a fattening bullock, together with the food consumption figures (silage and oats), the starch equivalent of the silage was derived from the performance of the four steers as 11.1 (63 per cent of the silage dry matter). From its analysis, good grass silage would be expected to have a starch equivalent of 50-55 per cent of the dry matter, or, in this case, about 9.3. Since the silage fed contained a considerable surplus of protein for fattening purposes, there is no point in giving the derived protein equivalent figure, beyond noting that it was understandably low.

Three weeks after the end of the feeding trial the animals were sent for slaughter. During this period the ration was modified, due to the silage having been used up. A poorer quality silage was fed for two weeks and was then replaced by roots and hay. The corn was also increased to 6 lb. per head by the addition of maize. Details of weights, gains, and carcass quality are given in Table 1.

Table 1

Fattening Steers

Animal	Weight at Start of Trial			Weight at End of Trial			Av. Liveweight Gain per Day	Carcass Weight	Killing-out Percentage
	cwt.	*qr.*	*lb.*	*cwt.*	*qr.*	*lb.*	*lb.*	*lb.*	
A	8	3	16	11	–	26	1.80	757	61
B	8	1	2	10	1	18	1.63	680	59
C	8	1	26	11	–	2	2.25	719	60
D	7	3	8	10	–	4	1.69	664	60
Average	8	1	13	10	2	20	1.80	705	60

The animals were graded three special and one A plus, but killed out better than the grader expected. The comment from the slaughterhouse was that three of the animals were rather too fat for the butcher, indicating that at least part of the finishing ration of cereals might have been saved.

Satisfactory Milk Yield Fourteen pedigree Ayrshire cows were used in the dairy cattle trial, which lasted from January 17 to March 14, 1954. Thirteen of these animals had been used in a similar trial last year. Careful records were kept of all foods fed, and individual cows

were rationed according to yield. Silage was given in three feeds and the concentrates at milking times. The cows were housed during the entire period, being turned out for exercise every morning for a short time. They were milked twice daily, and throughout the trial there were no signs of ill-health. The composition of the daily ration per head was as follows:

Maintenance and the first two gallons	60 lb. silage 10 lb. oats
Over two gallons	3 lb. purchased dairy cake per gallon

The cows were officially recorded, and it was found that milk yields were well maintained during the trial. Total daily production dropped from 495 lb. to 432 lb. (1.6 per cent per week), and the total production during the trial amounted to 2,431 gallons of milk at 3.9 per cent butter fat. At the start of the trial the cows had been in milk for an average of 112 days.

The animals were weighed on two successive days after morning milking at the start and at the end of the trial. The average weight per cow was 9 cwt. 3 qr. 9 lb. at the start, and 9 cwt. 2 qr. 18 lb. at the end of the trial —that is, each cow lost on average 19 lb. during the trial. Allowing for this loss in weight, the S.E. and P.E. values for the silage were calculated from the performance of the animals, using the accepted feeding standards and S.E. and P.E. figures for the oats and dairy cake that had been derived from a complete analysis of the foods. The comparisons between the actual and expected values for S.E. and P.E. were:

Starch equivalent from analysis	9.5	(50–55 per cent of dry matter)
Protein equivalent from analysis	1.75	(60 per cent of crude protein, as determined)
Starch equivalent from performance	8.1	(45 per cent of dry matter)
Protein equivalent from performance	1.71	(58 per cent of crude protein, as determined)

Efficient Use of Silage The results of these trials show that Dairy Shorthorn steers reared on a ration composed predominantly of grass or silage can be fattened on a diet mainly or entirely of silage. The liveweight increase of 1.8 lb. per day throughout the period is very satisfactory. The starch equivalent of the silage, as derived from the performance of the animals, was higher than one would expect from analysis, but agrees broadly with figures obtained by Dodsworth and Campbell [2] from animals being fattened on silage. Similar results were obtained from silage-feeding trials in Northern Ireland. This shows that silage is used efficiently by the fattening animal, and can play a major part in the diet of such animals on many farms.

It has also been shown once more that silage can maintain a satisfactory level of milk production. The starch equivalent of this silage, as calculated from the performance of the animals, was about 15 per cent below that expected from chemical analysis, but the protein equivalent agreed closely with the expected value. It is interesting to note that if no account is taken of the small loss in average weight of the animals, then the value for starch equivalent derived from performance agrees closely with the value expected from analysis. On the other hand, if the silage is assessed according to Hallsworth's regression equation [3], the starch equivalent of the silage would be 43 per cent of the dry matter, which agrees closely with the figure obtained by performance.

Costs and Returns Fairly accurate costings are possible from these results, since records of all foods used during the experimental periods are available, and time-sheets provide a good basis for the allocation of labour charges. The expenditure per cow for the eight weeks of the trial with the dairy cows is given in Table 2. In the case of the bullocks, since these were born, reared and fattened on the farm, an even more complete statement (Table 3) can be formulated, although it is realized that several of the items concerned are not easy to express precisely in terms of money.

Table 2

Expenditure per Dairy Cow during Trial (8 weeks)

		£	s.	d.
Food	Silage, 28 cwt. @ 2*s.* 6*d.*	3	10	0
	Oats, 5 cwt. @ 17*s.*	4	5	0
	Dairy cake, 234 lb. @ 3½*d.*	3	13	0
	TOTAL FOOD COSTS	11	8	0
Labour (based on £16 per cow per year)		2	13	0
Overheads and herd replacements (based on £24 per cow per year)		4	0	0
Total Costs per Cow		18	1	0

Average yield per cow = 173 gallons. Cost per gallon of milk = 2.1*s.*

Table 3

Costings per Bullock (birth to 28 months)

		£	s.	d.
Food	Milk, 50 gallons @ 2*s.*	5	0	0
	Hay, 9 cwt. @ 5*s.* 6*d.*	2	9	6
	Calf nuts, 4½ cwt. @ 40*s.*	9	0	0
	Corn (mainly oats), 14½ cwt. @ 17*s.*	12	10	9
	Silage, 162 cwt. @ 2*s.* 3*d.*	18	4	6
	Mangolds, 6 cwt. @ 2*s.*		12	0
	Grazing:			
	1st summer (120 days)	1	10	0
	2nd summer (210 days)	5	0	0
	TOTAL FOOD COSTS	54	6	9
Labour	60 hours @ 2*s.* 6*d.*	7	10	0
Overheads, including cost of calf but offset by value of manure			nil	
Total Costs per Beast		61	16	9
Returns	Sale of bullock (average)	81	0	0
Profit		19	3	3

From the costings standpoint it is clear that the use of silage for milk production achieved a much lower than average cost per gallon over the period under review: the average figure quoted by A. S. Barker from a 1952-53 survey, for instance, was 2.8*s.* for winter milk. Within limits, good quality silage can be used to replace dairy cake at half the cost, even allowing 5*s.* per ton for the cost of cutting out, transporting and feeding the silage. Similarly, the total food costs for the bullocks have unquestionably been reduced by the fairly heavy use of silage during their second and third winters. Even so, the actual cost of fattening exceeds the price return, since the final payment worked out at 1.35*s.* per lb. live weight, and the cost at 1.55*s.* per lb. liveweight increase. This, however, is making no allowance

for the value of the manure. Taking the whole life period of the bullocks, a satisfactory profit was returned in this instance.

We are grateful to the Principal of the Cheshire School of Agriculture for permission to carry out these experiments.

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SPRING WHEAT

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Because of the very wet autumn, many farmers, even in the traditional winter wheat areas, will have to sow spring varieties this year. Extremely good results can be expected if the right kinds are chosen.

THE wet summer of 1954 has been followed by a wet autumn, and thousands of acres intended for winter wheats are still unsown, even in the drier areas of the south-east. If a wheat crop is wanted on this land, it will have to be spring sown. In this case the spring wheat will be second choice, but there will also be many crops which were deliberately planned for spring sowing. What factors, then, should decide between winter and spring wheat when the weather allows a free choice?

Direct yield trials between winter and spring crops are difficult to manage and are often unsatisfactory. Indirect comparisons, however, strongly suggest that winter wheat gives the higher yield on normal soils in the traditional wheat-growing areas. This is particularly true in a hot, dry season, such as occurred in 1947. It is in the wetter parts where spring wheat appears to have the advantage over winter wheat. Apart from the difficulty of autumn sowing in such districts, wheat often does not thrive in a very wet winter. Spring wheat, however, has grown well in such areas, and trials yielding 30 cwt. per acre or more have been common in the west and north-west. One trial in west Wales in 1953 gave a yield of over 50 cwt. per acre—a figure rarely exceeded by winter wheat, even in the traditional wheat areas.

Aside from its suitability to the wetter districts, there are special places for spring wheat, even in the winter wheat areas. On some of the extremely fertile soils the main difficulty with winter wheat is to keep the crop standing up. Under these conditions spring wheat, with its shorter growing period and less vigorous tillering, may stand and produce as much, or more than, the winter crop. This is perhaps a temporary situation resulting from the

lack of a completely satisfactory stiff-strawed winter wheat, and the position may alter if improved winter varieties are developed.

Spring wheat also has a place in helping to control certain diseases of cereals and some of the more difficult weeds. The foot rot diseases—Take-all and Eyespot—are both troublesome in areas where much wheat and barley is grown. On land known to be infected, wheat is less likely to be seriously attacked if it is sown in the spring, since there is less time for the disease to spread. The shorter growing time also enters into the weed question. Although chemical control of weeds has developed rapidly in the last few years, cultivations can still play an important part, particularly in the case of some troublesome species such as wild onion and wild oats. Both these weeds are favoured by autumn sowing, and in any campaign to control them the sowing of spring crops is an important feature. In such circumstances, autumn-sown wheat may be excluded from the rotation for some years.

Another use of spring wheat results from the fact that it is usually the last cereal crop on the farm to ripen. This is of value in lengthening the period in which combine harvesters can work, and, indeed, many farmers sow a proportion of spring wheat with this in mind.

Apart from the occasions where spring wheat is chosen for reasons relative to its field characters, one of the strongest attractions in growing spring wheat at the present time is in the quality of the grain of the principal varieties—Atle, Atson and Fylgia. With the changed conditions of marketing, many growers need to have at least a proportion of their wheat of a quality readily acceptable to the buyers. Atle and Atson are excellent milling varieties and rank in the highest class of wheats grown in this country for bread-making. Atle is well known to the millers; its small red grain is quickly recognized, and it is probably the easiest variety to sell at harvest time. Fylgia is also a good bread-making variety, and although only average in milling quality, is known and usually readily accepted by the miller.

The good quality winter wheats all give only moderate yields of grain and, except for Holdfast, have straw of only fair standing power. The difference, therefore, between a good yield of spring wheat and a moderate yield of winter wheat may not be so great, and where milling quality in the grain is essential, the spring varieties have a strong claim for consideration. Whether it is more profitable for a grower to aim at quality first and quantity second, or vice versa, is a question which can only be answered with knowledge of all the local conditions.

Some Cultural Points The general features of cultivation of spring wheat are similar to those for all spring cereals, but two or three points deserve emphasis. Early sowing usually pays with all spring cereals, but it is particularly important for spring wheat, which is slower growing than either oats or barley. In most areas February sowing is worth while if weather permits, and, except in very special circumstances, sowing should certainly not be delayed after March. It is usually considered that if sowing cannot be done before April, barley will be more profitable than wheat. When an April sowing of wheat is necessary, however, an early-ripening variety should normally be chosen.

Recent trials have emphasized another important point in the cultivation of spring wheat—that of seed rate. Possibly because development is rather slow, a fairly high seed rate is necessary to obtain the maximum crop. The actual quantity will vary with fertility level, time of sowing, soil cleanliness,

etc., but records from trials suggest that the rate should rarely be below 3 bushels (186 lb.) per acre, even though the seed size is small in several of the varieties.

Recent trials have also shown that spring wheat can make profitable use of fairly generous dressings of nitrogen. The crop stands well, the present varieties show good resistance to Yellow Rust, and provided the other manurial constituents are adequate, the nitrogen supply should be maintained at a fairly high level. As with seed rate, however, the exact quantity of fertilizer to apply can only be decided with knowledge of the local circumstances.

The Right Variety The great development in the cultivation of spring wheat has been due mainly to the use of the variety Atle. This Swedish wheat has white chaff and small red grain of high quality. It matures moderately late but gives high yields of grain with straw of medium length and good resistance to lodging. Atle has a high resistance to both Yellow Rust and to Loose Smut. The early growth of Atle in the field is rather slower than with several of the quicker-maturing varieties, and it is not a good competitor with weeds. For these reasons, however, it is a very good cover crop for undersown grass and clover.

The Swedish breeders of Atle have recently introduced another variety, Atson, after it had shown good results in trials in England for several years. Atson has been recommended by the National Institute of Agricultural Botany because it gave higher yields than Atle, while maintaining the same good grain quality. It is very similar to Atle in the field, maturing a little earlier and having slightly longer straw. The resistance to Yellow Rust is almost as good and the resistance to Loose Smut is similar.

The alternative winter-spring variety Bersée is used chiefly as a winter wheat, but if sown early it can give at least as high a yield as Atle. It is, however, even later maturing, and the grain quality is poor both for milling and for bread-making.

The earliest ripening variety on the N.I.A.B. Recommended List is Fylgia. This is another Swedish variety with red chaff and pale red grain, which is of good bread-making quality, although soft in the milling character. Fylgia ripens a week or more earlier than Atle but frequently gives a 10-15 per cent lower yield. It is usually chosen only for late sowing or for districts where earliness is of first importance. A new variety, Fylgia II, is being tested, but has not yet completed its trials. It is distinct from Fylgia, although of the same parentage, and preliminary trial results suggest that although giving higher yields than Fylgia, it matures slightly later.

Other new varieties are in trials and one, a German variety named Peko, has attracted some attention recently. The results of trials of this variety are not yet complete, but it appears to stand as well as Atle, although having longer straw, and to give a yield of grain superior to Atle and more comparable to Atson. The reports on the grain suggest that it is of an entirely different type to Atle and Atson, being soft in milling character and more of a biscuit-making variety. Maturity is very similar to that of Atle.

A number of other spring wheat varieties have been tested since the end of the war and some of these are grown on a small scale. Recent trials conducted by the National Agricultural Advisory Service have suggested that one of these, Progress, may have a special value on soils where there is a deficiency of manganese. It shows a greater tolerance of this deficiency than Atle, although spraying may still be necessary.

SPRING WHEAT

Spring Sowing of Winter Varieties A lot of seed originally intended for autumn sowing will have had to be held over in this very wet season, and some farmers will want to use this seed if possible. It is safe to sow an alternative variety such as Bersée in the spring, but if true winter varieties are sown a little too late there is a risk of a complete failure, the crop not coming into ear, or earing very irregularly and very late. Details of experiments on this subject were reported in this JOURNAL in November 1953.* A list was given there of the commoner wheat varieties and the latest safe sowing dates. This list has been slightly amended to bring it up to date and is included again here.

King II Heine VII Pilot Scandia Rivet Wilma Victor Juliana Staring	Varieties which are not recommended for sowing after the end of December and cannot be sown after the end of January without risk of unsatisfactory results.
Little Joss Steadfast Minister Welcome Jubilégem Squarehead's Master 13/4 Masterpiece Holdfast Redman Yeoman Cappelle Desprez Nord Desprez Vilmorin 27 Eclipse Hybrid 46	Varieties which can normally be sown safely until mid-February and can be sown until the end of February without serious risk of failure.
Bersée Atle Atson	Varieties suitable for sowing in March.
Fylgia	Can be sown during April, although earlier sowing is recommended.

This list takes in the more widely-grown varieties of wheat in England placed in the order of their increasing suitability for late spring sowing. The varieties have also been classified into groups, but it must be stressed that there is no well-defined division between the groups. The last variety of one group will be very similar to the first variety of the next group.

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* *Spring Sowing of Winter Cereals.* C. S. ELLIOTT, H. N. GREENWOOD and B. C. R. REISS, **60**, 378-83.

SOCIETY OF CHEMICAL INDUSTRY

Agriculture Group

FORTHCOMING MEETINGS

1955		
January 17	The Analysis of Insecticides: Tar Oils and Summer Oils	DR. J. T. MARTIN
	The Analysis of Weed-killers: MCPA and Dinoseb	MR. GARDNER
January 18	Leaf Leachates as a Factor in Soil Pedogenisis	DR. C. BLOOMFIELD
February 15	Recent Aspects of Fertilizer Practice	MR. B. M. CHURCH and DR. G. W. COOKE

Full particulars from the Gen. Sec., 56 Victoria Street, London, S.W.1.

THE RECLAMATION OF DERELICT WOODLAND

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Increasing interest is being shown in the reclamation of derelict woodland. Mr. Smith discusses this problem in the light of the Reed Wood, Royston, project.

IT is significant that about a thousand landowners and farmers attended a demonstration of land reclamation held last summer at Reed Wood, Royston, Hertfordshire. In the past, work of this nature was scarcely worth while, owing to its high cost, and there was always doubt whether reasonable crops could be grown. But with the advance of agricultural science, developments in machinery design, and the financial assistance of Government grants, the reclamation of many areas of derelict woodland is now worth consideration.

Mr. E. S. Handley, the owner of Reed Hall Farm, had a block of 30 acres on which the stand of hardwoods (oak and ash) had been felled early in the Second World War. Since then there had been an appreciable growth of stooled ash, coppice and scrub; few of the stumps had rotted. This wood was surrounded by fertile agricultural land in a high state of cultivation and it was hoped that, following reclamation, it would conveniently fit into an existing holding of 161 acres.

A visit to Reed Wood in December 1953 showed that the undergrowth was virtually impenetrable—a first-class fox covert. The soil was typical of north-east Hertfordshire—a boulder clay overlying chalk with about 12-15 inches of top soil, with chalk freely available in the immediate subsoil. There was no evidence of serious drainage problems.

The soil was thought to be inherently fertile and likely to produce reasonable crops after adequate applications of fertilizers. This was subsequently confirmed by soil analysis. This question of fertility is of first importance; for it is useless spending large sums in clearing scrub and tree stumps only to find that the land is so poor that its reclamation will prove to be uneconomic.

A contractor estimated that the cost of clearing top growth, bulldozing roots and stumps, extracting small roots and heavy discing would work out at £75 per acre; this figure included burning the scrub but not large tree stumps. A grant of £35 per acre was approved by the County Agricultural Committee,* thus reducing the cost to £40 per acre. Further reductions in cost could be made by taking advantage of Income Tax concessions as follows:

	£ s.	£ s.
Cost per acre after deducting grants		40 0
Less allowances against taxable income:		
Investment allowance 10 per cent of £40 @ 9*s.* in £	1 16	
Capital expenditure claim 10 per cent of £40 for 10 years @ 9*s.* in £	18 0	19 16
Net cost to owner after 10 years		£20 4

* Available to occupiers under the Marginal Production Scheme and Ploughing Grants.

Top Growth and Roots Mr. Handley decided to proceed with the reclamation of 10 acres as an experiment, and the top growth was cut by hand and burned during the preceding winter. It may be argued that hand-cutting is a laborious method, but it can be adopted with advantage when, because of bad weather, farm or estate labour cannot be fully employed on normal work. It is sometimes possible to arrange for people from a nearby village to clear the top growth in return for the firewood, bean poles, etc. which are available. The use of heavy tackle on strong land during bad weather is not advocated, since excessive poaching and loss of top soil would most probably result. The clearance of a large amount of brushwood is a serious problem which may be partially solved by the use of the chemical spray 2,4,5-T (trichlorphenoxyacetic acid) which makes the scrub brittle, so that it is easily cut and burned.

Some people prefer to cut the top growth and extract the roots as a separate operation; in that event, the use of mechanical scrub cutters is worth considering. These machines consist of an hydraulically-operated jib fore-end mounted on a standard type of tractor, the jib being fitted with a high speed cutting blade of varying design according to the work which has to be tackled. These cutters are very effective, but it is helpful to have some method of collecting the brushwood and conveying it to the burning point. Hydraulically-operated grabs, working in conjunction with buck-rakes, are a usual combination, but there is scope for the introduction of an improved machine to handle a greater quantity of brushwood. An alternative method is to remove saplings, coppice and medium-sized roots by bulldozer, but to conserve top soil, the roots should be shaken by the bulldozer blade and left in heaps for burning. Wheeled tractors can be used on the lighter scrub, and additional wheel-gripping power is obtained by fitting sectional tracks to the rear wheels. A usual combination of machinery for this class of work is a medium bulldozer with a winch and towing a four-tined ripper. In addition to taking out scrub by the roots, the rippers break up the subsoil to a depth of about 18 inches, which assists aeration and drainage.

Tree Stumps Having cleared the top growth and roots, the next job was the removal of tree stumps, which had an average diameter of 3½ feet. Heavy duty bulldozers made light work of these, but there was some loss of top soil and a fair amount of subsoil was brought to the surface. All but the largest stumps were tackled with bulldozers of about 40 h.p., although it took longer to do it. Cable-operated winches were impressive, but this method was comparatively slow because of the time spent in preparation. Possibly the simplest way of extracting roots is by high explosive. It was found that the largest stumps at Reed Wood could be completely blown out with about 3 lb. of gelignite. The method demonstrated was to bore obliquely into the soil under the stump at several points round the circumference to a depth of about 3 feet. After preparing a "chamber" by firing a low charge of explosive, the main charge was fired either by plain detonators and safety fuses or electric detonators. The advantage of this method is the relatively small loss of top soil, and if the charge is large enough there should be no problem of stump disposal!

The burning of tree stumps is a major problem. When contemplating clearance work, it is worth while exploring the possibilities of dumping the stumps into a pit, which can subsequently be levelled. It is folly merely to leave the roots in large heaps, for they will inevitably become infested with rabbits. The secret of burning is to dislodge as much soil as possible by

constant moving and exposure to the weather. Large bonfires should be made, using the mechanical grabs for loading, and the spaces between the stumps should be filled with dry brushwood. Old motor tyres and waste fuel oil are helpful in keeping a fire ablaze.

Ready for Cropping With the stumps removed, and the rooter having traversed the land in both directions, the field was ready for discing, twice with a heavy set of ploughing discs and twice with medium disc-harrows. Discing was best where the rooter had been working, but on land which had simply been bulldozed a single-furrow plough was considered to be a better implement.

The discing of the 10 acres was completed by early June 1954, and Mr. Handley has since sown mustard and rape as a green crop in preparation for spring wheat. The soil should work down to a reasonable seedbed and, according to the analysis, the only mineral deficiencies are phosphate and potash; but neither of these is acute. It is reasonable to suppose that there will be an appreciable increase in capital value when the land has been brought into production, and this increase may be estimated at a minimum of £35 per acre. Furthermore, the capital outlay should be fairly quickly recouped in returns from crop yields, and the first year's receipts might be calculated thus:

	£	£
Wheat—say 5 qr. per acre @ £6		30
Less cost of seed, fertilizers and labour, including harvesting–say	20	
interest on capital invested—5 per cent on £40 ...	2	22
Net return per acre		£8

It appears therefore that at a cost of £40 per acre (ignoring Income Tax concessions but allowing for grants), the capital outlay is likely to be recovered out of profit within five or six years. If, however, drainage problems arise necessitating additional expenditure, the recoupment of capital would be correspondingly deferred.

The conclusions reached at the Reed Wood demonstration were that the reclamation of derelict woodland of this nature is a sound financial proposition, provided the land is capable of growing reasonable crops without involving considerable expense in heavy dressings of lime and fertilizers. These reclamation schemes are particularly worthy of consideration in predominantly arable areas in order to reduce damage to adjoining crops by pests and injurious weeds. As more of this work is put in hand, it is to be hoped that new techniques will be evolved and new machines employed so that better and cheaper reclamation can be achieved.

British Council Report, 1953-54

The twentieth Annual Report of the British Council, published last month (price 2*s.* 6*d.*), records that since 1946 the number of Colonial students in Britain has risen from 1,000 to 8,000 and the total of overseas students is now estimated at 25,000. In the period, Council staff met on arrival nearly 12,000 students and found private lodgings for over 7,000. Nearly 6,500 attended vacation courses.

THE SECOND BRITISH WEED CONTROL CONFERENCE

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TWELVE formal papers and forty-eight research reports were presented to over 400 members from home and abroad at the second British Weed Control Conference, held at Harrogate on November 2-4, 1954. The formal papers dealt with subjects such as weed seeds and their dispersal, legislation in respect of weeds and weed seeds, legal aspects of spray damage, application problems, and weed control in perspective. Some of the headings under which research reports were grouped included horticulture, grassland, herbage, seed crops, legumes, cereals, row crops and flax, and the control of grass. It is impossible in the space available here to do more than select from a few of the research reports, matters which are likely to be of practical interest, but the papers and reports, and an edited version of the discussion, together with the Report of the Recommendations Committee of the Council, will be published later in the Conference Proceedings.*

Weed Control in Cereals Work on the spraying of oats in 1951-53 by the A.R.C. Unit of Experimental Agronomy, in co-operation with the N.A.A.S., was summarized in a research report presented at the first Conference in 1953. One of the interesting features of the results was the apparent resistance to MCPA of spring oats when in the 1-3 leaf stage. This finding was subsequently followed up by experiments, reported by MESSRS. J. G. ELLIOTT and J. D. FRYER, which were designed to compare MCPA and 2,4-D applied at the 1-3 leaf stage with similar applications at the normally recommended time of application (the 6 leaf stage). MESSRS. T. C. BREESE and R. H. HIRST also gave an account of fourteen experiments of a similar nature. Both reports conclude that MCPA (potassium or sodium salt) may be used on spring oats at the 1-3 leaf stage of growth without harm to the yield or appearance of the crop. The slight abnormalities which occurred in the experiments were insignificant. Breese and Hirst also report that oats appeared to be no more susceptible at the 3-5 leaf stage than at the earlier growth stage, and this agrees with earlier work carried out by the A.R.C. and N.A.A.S. It would thus appear that oats may safely be sprayed from the time the first leaf has developed until the "boot" stage, and the 1954 Report of the Recommendations Committee does tentatively put this forward as a recommendation.

MESSRS. R. PFEIFFER, P. GREGORY and H. HOLMES presented a report on the use of "dinitro" weed-killers on winter cereals. Although results were available from one season only, the main conclusions the authors drew were based on the experience of spraying under fifty different conditions. Spraying winter wheat with DNC at 4-6 lb. acid equivalent per acre in the period December 1953-February 1954 gave a highly satisfactory control of most autumn-germinating annual weeds. The effect on the crop appeared to be the same as from similar spraying treatment in the spring, and only when severe frost occurred within ten days after spraying did scorching of the wheat exceed the slight amount expected from a normal spring applica-

* To be obtained from the Joint Secretary, Mr. W. A. Williams, Association of British Insecticide Manufacturers, Cecil Chambers, 86 Strand, London, W.C.2.

tion. Only in one instance did severe scorch lead to a reduction in yield. The spring-germinating weed population appearing after winter treatment seemed to have little influence on the yield, and the investigators suggested that this might be due to such weeds being too small to compete with the established crop. Dinoseb (DNBP) was also tried and, when used at the rate of approximately ¾ lb. acid equivalent per acre, appeared to give similar results to the treatments receiving 6 lb. DNC acid equivalent per acre.

The stimulating effect of DNC to cereal crops, which has been noticed in the field, has been investigated by a Dutch worker, DR. P. REIPMA, who found that DNC applied at the 4 leaf stage in weed-free, autumn-sown cereals may result in an increase in yield of up to 10 per cent. This increase he found to be due to a greater number of grains per ear and a higher grain weight. Although Reipma could offer only suggestions as to why this should be, he was able to show, at any rate, that it is not due to a nitrogen effect, as has previously been suggested.

Weeds in Other Crops A report by MESSRS. W. Q. CONNOLD and E. I. PRYTHERCH reviewed information available within the N.A.A.S. on the use of sulphuric acid for controlling weeds in kale. The spraying of kale and some other brassica crops has been carried out commercially with success. The factors involved for such successful work are several. The authors suggested that one of the more important may be the effect of a canopy of weeds in protecting the crop from the acid. Where the canopy is more or less complete, the stage of growth of the crop is probably of little importance: where the canopy is patchy or non-existent, then the stage of growth of the crop is more important. It appears that fairly early spraying is the best, since older plants suffer a greater set-back. One experiment was quoted where spraying kale at the 6 leaf stage led to only a slight reduction of the final yield, whereas spraying at the 2 and 4 leaf stages led to greater damage. Other information suggested that the 1-3 leaf stage was the best time. The strength of acid used varied, and it seemed that 15 per cent B.O.V. was somewhere near the upper practical limit. The value of a top dressing of nitrogen, given within a short time of spraying to aid recovery, was stressed.

The control of wild oats in peas for harvesting dry by mixing a herbicide with the soil, has been investigated by MESSRS. P. GREGORY, J. D. REYNOLDS and J. M. PROCTOR. Trichloracetic acid (TCA) and other chemicals were applied just before the land was worked down for sowing. The check to the peas were only slight where up to 7½ lb. per acre of TCA was used, but more severe where up to 15 lb. was applied. The control of wild oats achieved was promising, even at the lower rate of application. The results with other chemicals were disappointing. The use of TCA and other chemicals just before the peas emerged, or when the peas were 2-3 inches high, did not give satisfactory results. MR. L. G. SPENCER reported similar experiments using *iso*propyl phenylcarbamate (IPC) and chlor IPC, where results had also been encouraging.

In another report Messrs. J. D. Reynolds, J. M. Proctor and P. Gregory discussed the possibilities of low-volume application of dinoseb on peas for harvesting dry. Results of experiments indicated that a reduction in volume rate from 100 to 60 gallons had no effect on yield, and that there was only a slight decrease in yield between 60 and 30 gallons. There was a significant decrease between 30 and 15 gallons. A pressure of 30 lb. per square inch gave better results than 100 lb. per square inch. Results as a whole suggest that the alleged dangers of low-volume application have been exaggerated,

but confirm that high-volume applications are more reliable and effective in the long run.

A development reported both from Sweden by MESSRS. K. FRÖIER and H. ZIENKIEWIEZ and from Denmark by MR. P. S. FREDERIKSEN was the use of a mixture of DNC and MCPA on fibre flax. The two chemicals together were said to control a much wider range of weeds than either alone.

Experiments reported by PROFESSOR R. L. WAIN have opened up new possibilities in the field of selective weed control. Chemicals have been synthesized in the laboratory (called shortly "MCPB" and "2,4-DB", etc.) which, although harmless to plants in themselves, can be oxidized in their tissues and converted there to highly active growth-regulating substances, such as MCPA and 2,4-D. Certain plant species, however, appeared to be immune to some of these materials. This lack of response was shown to be due to the fact that, in these particular plants, the enzyme system necessary to convert the applied chemical to the hormone was not present. Thus it was found that red and white clover and celery, for example, were practically unharmed when treated with some of these new chemicals at 2 lb. per acre. On the other hand, a number of noxious weeds, such as creeping thistle, fat-hen, annual nettle, fumitory and charlock, were controlled by one application of certain of these chemicals at 2 lb. per acre.

AGRICULTURAL STATISTICS: ENGLAND AND WALES

GLASSHOUSES (*a*) (July 1954)

	July 1953	July 1954
TOTAL AREA OF GLASSHOUSES	*acres*	*acres*
With heating apparatus	3,926	3,906
Without heating apparatus	725	756
TOTAL	**4,651**	**4,662**
CROPS IN GLASSHOUSES AT JULY 3		
Tomatoes	3,060	3,092
Cucumbers	500	480
Other vegetables and herbs	35	33
Grapes	35	32
Peaches and nectarines	19	18
Other fruits	4	5
Carnations	185	182
Roses	104	108
Orchids	10	10
All other flower and foliage crops	350	344
All other crops not specified above	60	67
Remaining glasshouse area (being the area unused at census date, or used for purposes not shown above)	289	291
TOTAL	**4,651**	**4,662**

(*a*) Including crops grown in glasshouses on holdings of 1 acre or less. Holdings with less than 1,000 sq. ft. of glass (including lights etc.) are excluded. Also including Dutch light structures which were glazed at the census date.

SMITHFIELD, 1954

FROM the grey, prosaic streets of West Kensington, you enter the Smithfield Show at Earls Court through the dark outer hall, where the interminably clicking turnstiles form a ground bass to the cries of the catalogue sellers. You push open the swing doors and quite suddenly, like Alice, you are in another world—a world of light and colour, a world murmurous with a thousand sounds, human, animal and mechanical, and over all that dry, slightly acid smell blended of livestock, fodder and straw, which here, in London, imparts a suggestion almost of unreality. This five-day show, the premier of its kind throughout the world, draws its visitors from overseas, and town and country alike. It presents Britain's best in fat cattle, sheep and pigs, and the ingenuity and enterprise of our agricultural machinery manufacturers. It is a shop window on a stupendous scale, whose aisles are thronged for nine hours every day by a constantly changing pattern of people—discussing, pondering and appraising the merits of stock and machines.

It is a far cry to the first Smithfield Show which was held by the newly-formed Smithfield Club as long ago as 1798 in Wootton's Livery Stables at Smithfield. As the show outgrew this modest site, the location was changed first to Dixon's Repository in the Barbican, then to Sadler's Wells, to Baker Street and, in 1862, to the Royal Agricultural Hall at Islington. The event continued to be held annually at the Royal Agricultural Hall from 1888 to 1938, steadily extending its scope to include more and more entries and appropriate trade exhibits—from agricultural machinery and implements to feedingstuffs, seeds and veterinary equipment. After the Second World War, a new venue had to be found, and so, since 1949, under the Presidency of His Grace the Duke of Norfolk, the Smithfield Show Joint Committee, consisting of members of the Smithfield Club, the Society of Motor Manufacturers and Traders, and the Agricultural Engineers' Association, have staged the show at Earls Court.

For the first time at Earls Court, this was a "free-market" fatstock show, and over 1,300 live animals (cattle, sheep and pigs), representing Britain's foremost breeds, made it a record entry. In addition, there were 429 special entries in the carcass section, housed in the new Annexe to the Exhibition and auctioned on the third day of the show.

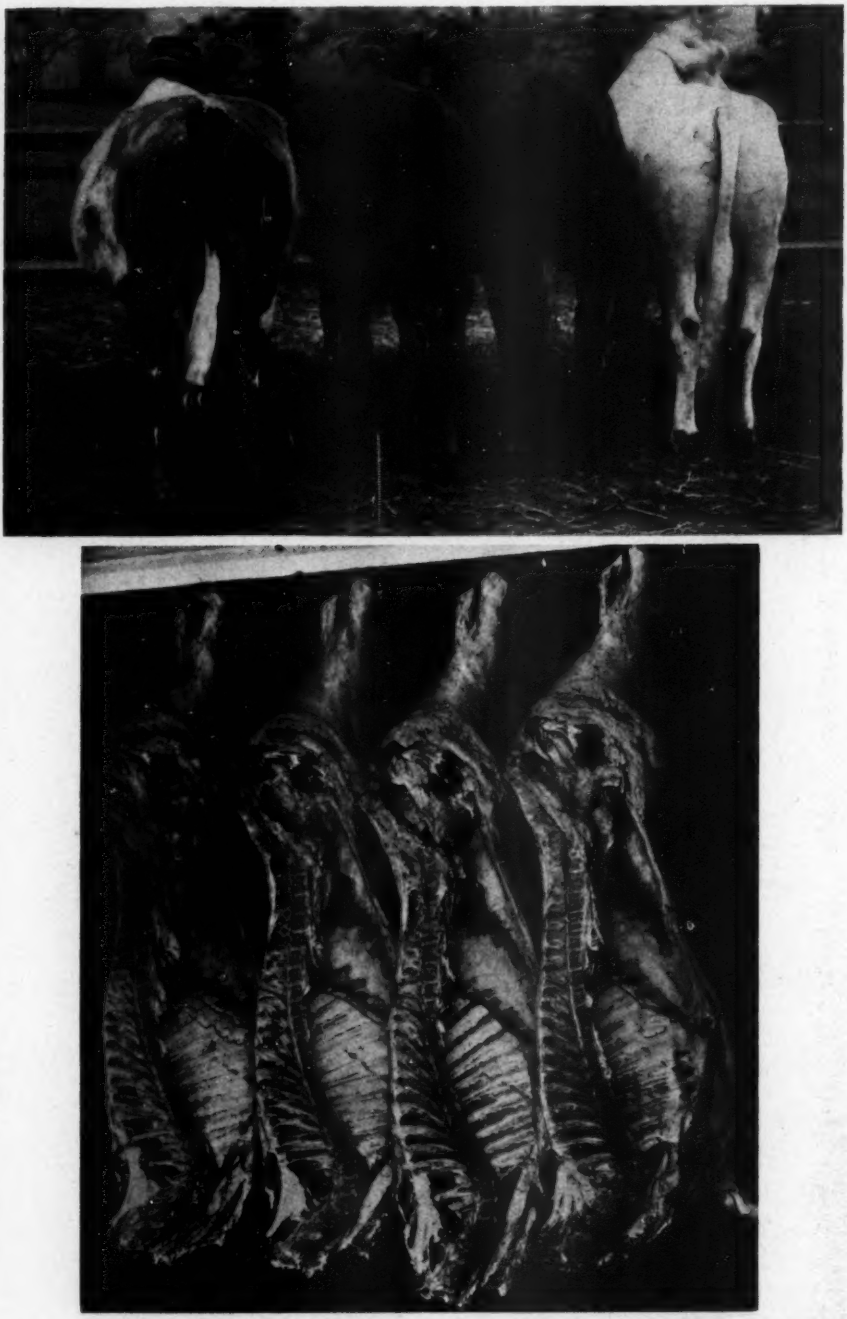
Under the bright glare of the lights over the ring, judging started early on the first morning. The keenly contested supreme championship went to the Scottish Malt Distillers' Aberdeen-Angus x Shorthorn heifer "Hilda" who, it will be remembered, also carried off the championships of the Birmingham and Edinburgh fatstock shows this year. At 2 years 11 months, she weighed over 11¾ cwt. and was subsequently auctioned for slaughter at £1,000. This star of three shows had had her last glorious hour. Major Gordon-Duff's pure-bred Aberdeen-Angus "Enji of Cobairdy", breed champion at Edinburgh and runner-up to "Hilda", was placed reserve champion. The Duke of Norfolk Perpetual Challenge Cup for the breed society with the best exhibit of three pure-bred steers was awarded for the third time in succession to Aberdeen-Angus, with the Galloway team in reserve.

There is no doubt that this sixth Smithfield Show at Earls Court was an outstanding success. With the pluvial experiences of so many of the 1954 agricultural shows still fresh in mind, there is much to be said for a show completely under cover—a thought which I am sure would be endorsed by the 65,914 people who attended it.

S.R.O'H.

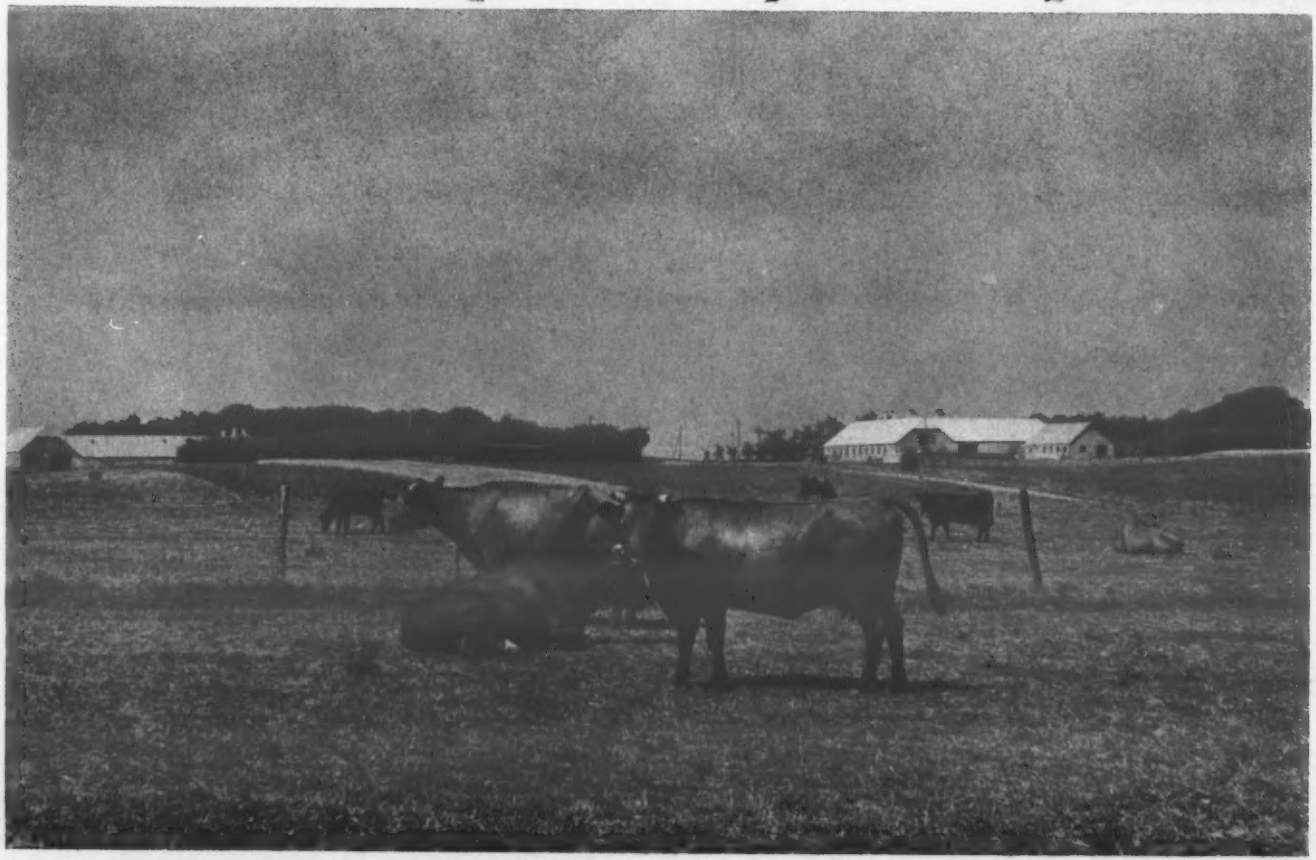
Smithfield, 1954.

SILAGE FOR BEEF AND MILK PRODUCTION **(Article on pp. 474-8).**



Photos: *G. S. McCann*
Donald C. Good

The four Dairy Shorthorn steers used in the trials. Slaughtered at just under 2½ years, they were graded three special and one A plus. (The carcasses are in the same order as the live animals above.)



The Agriculture of Denmark (Article on pp. 493-7).

Red Danish cattle in a typical setting.

Photo: *Danish Agricultural Council*

Photo: *Mustograph*

Bottle feeding time.

REARING MOTHERLESS PIGLETS AND LAMBS

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IT frequently happens, both in farming practice and in experimental work using farm animals, that it is necessary to rear young animals apart from their dams and without their dam's milk. Perhaps, through accident or disease, the dam is no longer able to rear her offspring, or perhaps for reasons of experimental design—for example, to eliminate risks of a parasite or other infection from the adult—it becomes necessary to remove the offspring at birth and subsequently rear it in isolation. To take over the functions of the dam is not difficult as long as a few simple principles are strictly adhered to, although it must be admitted at the outset that the dam is generally able to make a more satisfactory job of rearing her progeny than even the most conscientious farmer or research worker. For this reason, it must be the object of the human operator to imitate the dam as closely as possible. In practice, this means that the young must be kept warm and given a highly nutritious, clean, warm, and palatable feed at frequent intervals throughout the day, and, when very young, during the night too (although overfeeding must be avoided). How may these requirements be satisfied?

The importance of scrupulous cleanliness in all feeding bottles and troughs cannot be over-emphasized. Particularly when milk diets or foods containing high percentages of fat are used, the containers must be thoroughly washed out after every feed, and sterilization should certainly be carried out at least once a day. Where chemical sterilization is practised, great care must be taken to ensure that the utensils are well rinsed before use, since many of these agents, as well as detergents, are toxic to stock. Sterilization by boiling is a better method. Where rubber teats are used, these should be boiled as well.

The maintenance of body temperature, particularly of the very young animal, is also of the first importance. It frequently happens that orphan animals either refuse to eat, or perhaps are so weak that they are unable to eat normally, and unless they are kept warm they will soon decline and die. Any source of heat will, of course, be satisfactory, but where an electricity supply is available an infra-red heating lamp is cheap and very suitable. Young orphan animals, and particularly those which are weak and undernourished, should be kept within a temperature range of approximately 75-80°F. for at least the first few days, when their own mechanisms for maintaining body temperature have not yet begun to function efficiently.

Colostrum and its Substitutes Most orphan animals are reared on diets based either on cow's or goat's milk, but although these foods resemble more closely than any other the milk of the missing dam, there are important differences in the milk composition of different species which must be taken into account in the rearing diet. The following table shows how the milk of cows, goats, ewes, and sows differ in average composition. It is, of course, important to remember that with

cows there are important and well-known breed differences in the fat composition of the milk.

Average Composition of the Milk of Cows, Goats, Ewes and Sows

	Water	Fat	Protein	Lactose	Ash
			per cent		
Cow	87.25	3.80	3.50	4.80	0.65
Goat	87.88	3.82	3.21	4.54	0.55
Ewe	80.82	6.86	6.52	4.91	0.89
Sow	84.09	4.55	7.23	3.13	1.05

Although it is comparatively straightforward to find a substitute for the milk of any species by adding suitable supplements of fat, protein, sugar, minerals or water to cow's or goat's milk, it is much more difficult to replace the colostrum, or beestings. If at all possible, a young animal should always receive its dam's colostrum for at least the first twelve or twenty-four hours of life. It is in this very early period that the intestines are extremely permeable to the important globulin fraction of the colostrum, and it is this fraction that helps the animal to build up its resistance to a variety of infections. Recent experience indicates that this function of colostrum may, at least in part, be carried out by the inclusion of an antibiotic in the diet. In those cases where it is impossible to supply appreciable quantities of colostrum, either penicillin or aureomycin should certainly be included in the diet fed during very early life.

The other advantages of colostrum lie in its laxative properties and its high vitamin A content. Castor oil or medicinal paraffin are suitable substitutes as a laxative, and the essential vitamin A requirements may be satisfied by the inclusion of either cod liver oil or a stable synthetic vitamin A powder. Unfortunately, cod liver oil quickly loses its vitamin potency if exposed to air or light, it is difficult to mix in a diet, and, if used to excess, may induce a deficiency of vitamin E. Also it is best fed in an emulsified form. The synthetic preparations of vitamin A (and D) in the form of a powder, in which each particle of the vitamin is protected by a micro-crystalline wax, have none of these disadvantages and are, therefore, to be preferred.

Raising Piglets In theory, the ideal way to rear motherless piglets is to persuade a sow with a small litter of the same age to adopt them. The sow should be taken out of the pen when the young are added to her litter, and the piglets should be allowed to run together for 10-20 minutes before the sow is returned to the pen. In practice, however, a suitable foster-mother is rarely available, and there is then no alternative to hand-rearing. For this purpose, a suitable nest may easily be built with planks of wood, or even bales of straw, in any draught-proof outhouse. Heating is best provided by an infra-red lamp hung about 3½ feet above the ground, and bedding may be either wood shavings (preferably not sawdust) or short straw.

Feeding bottles fitted with rubber teats are not at all necessary even for the youngest pigs; an open, shallow dish, such as a baking tin, serves very well and it saves time and bother. If, at first, the head of each piglet is gently but firmly dipped into its food, it will very quickly learn to lap it up. Although it is probably advisable to offer the liquid food at about body temperature, the baby pigs will readily consume each feed if it is given at room temperature.

REARING MOTHERLESS PIGLETS AND LAMBS

If piglets are fed upon only cow's milk they generally die after about the first week. Satisfactory results may be obtained, however, if the milk is supplemented with skimmed milk powder at the rate of a tablespoonful to a pint of milk. Cream should not be added, and milk from high butterfat cows is best avoided. At first, five or six feeds should be given at regular intervals throughout the day (but not the night). At the end of a week this may be reduced to three feeds a day for the next three weeks. From the start it is best to offer both water and creep feed meal or pellets without stint. Considerable amounts of water will be drunk, even during the first few days, and from a week to ten days old the pigs will eat the dry food in increasing quantities, until, by three weeks old, it will be possible to wean them off the milk diet altogether.

In the first day or two of life it is advisable to mix some sugar (glucose or lactose is preferable to sucrose) in the milk at a rate of about 1 oz. to a pint. This helps to reduce the risks of deaths through hypoglycaemia, a disease all too common in very young pigs. The commonest nutritional disease in baby pigs is, of course, piglet anaemia, and to prevent this iron supplements must be offered during the first three weeks. One of the most satisfactory ways of administering the iron is to offer the pigs a sod of earth each day from which, by grubbing about, they obtain the minute quantities of iron which are necessary. Otherwise, anti-anaemia capsules or paste should be administered individually.

Alternatives to the diet suggested above have been proved in practice to be quite satisfactory. For example, reasonable rearing results have been reported from America when piglets have been offered cow's milk fortified with:

	grammes per quart
Sucrose	60
Ferrous sulphate	2.5
Cupric sulphate	0.2
Manganous sulphate	0.2
Potassium iodide	0.02

A diet used in this country and found to be giving good results consists of:

Cow's milk	1 pint
Lime water	½ pint
Glucose	1 tablespoon
Cod liver oil	10 drops
Sodium citrate	10 grains

When mixed together, these quantities provide enough food for eight pigs at each feed for 3-4 days. They will then require one and a half times or twice these quantities.

Recent work has shown that baby pigs may be weaned on to dry foods much sooner than is customarily imagined. If given a high protein (20-25 per cent) diet amply fortified with vitamins, minerals and an antibiotic, pigs at a week to ten days old may be weaned off milk substitutes altogether and given only dry food and water *ad lib.*

Care with Lambs Motherless lambs may be reared either by transfer to a foster-mother or by hand-rearing; the former method is much to be preferred, both for the sake of the lamb and the shepherd. In either method, however, it is essential that the lamb should receive colostrum, or, as second best, a suitable substitute. To ensure the least delay in

providing warmth, lambing should take place near a building in which there is either an open fire or an electricity supply. As soon as it is born the lamb should be brought to the warmth, rubbed dry and wrapped in sacking. It may be necessary to clean its mouth of membranes and to induce breathing by giving it a slap and applying artificial respiration. A foster-mother should be found at the earliest possible moment, and for this reason it is not worth waiting for another ewe to produce a lamb which is dead or which subsequently dies. The motherless lamb is best adopted by either a ewe with a single lamb, provided she promises ample milk, or a ewe whose single lamb has died.

The best chance of getting the lamb adopted is by wetting it with the waters of the ewe and presenting it to her before her own offspring. If adoption is tried some hours after a ewe has lambed, the orphan will have to be wrapped in the skin of the ewe's dead lamb, and the ewe's milk should be drawn off to avoid overfeeding at first. If the ewe shows signs of resenting the foster-lamb, she should be tied up until she no longer resists its sucking. When this point has been reached the lamb is assured of receiving colostrum, and it may well be worth while trying to secure by these means some colostrum for those lambs that are to be reared by hand. Or it may be possible to draw off by hand and feed to the orphan colostrum from a ewe who has some to spare. Failing this, it will be necessary to provide a substitute of cow's milk containing a suspension of vitamin powder, an antibiotic, and a teaspoonful of castor oil or a tablespoonful of medicinal paraffin. The amount and frequency of dosing with a laxative should be adjusted according to bowel activity. As ewe's milk contains up to 7 per cent fat, cow's milk of similar content should be used if available, but otherwise cream may be added to raise less rich milk to this figure. It is very desirable to use milk from the same cow every day.

The first feed should be given when the lamb is able to stand, and not later than about 1½ hours after birth. It should be given at 100°F. (body temperature) up to 4 tablespoonfuls at a time, as often as every two hours on the first day, and four or five times in twenty-four hours thereafter. If on each occasion feeding is stopped when the belly is level with the flanks, the common fault of pot-belliedness may be avoided. The first feeds will have to be given from a baby's feeding bottle with a rubber teat; these must be washed after every feed and sterilized once a day. As soon as possible, the lamb should be taught to drink from a bowl by sucking a finger in the liquid, as is customarily done with calves. By about 3 weeks, three feeds a day are normally sufficient. From about 2 weeks, lambs will take some solid food. A good mixture is one part each of crushed oats, flaked maize, and linseed sake. Locust bean meal may be found useful for preventing scouring, and it can replace some of the oats and maize. Good meadow hay should also be offered from 2 weeks onwards. When the lamb has become quite accustomed to solid food, milk feeding may be gradually reduced until, by 3 months, no more is given.

THE AGRICULTURE OF DENMARK

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Skilful, co-operative farming, combined with a high degree of specialization, has made the Danish agricultural industry one of the most prosperous in the world.

THERE is probably no country in the world where farmers have achieved such a high reputation as they have in Denmark. To the average Englishman, Denmark and farming are almost synonymous terms, but there is always a feeling that there must be some mystery or secret which the Danes have found but which has not come to light in Great Britain. Comparisons are often made between Danish and British farming to the disadvantage of the latter, but in any comparative study it is of fundamental importance to compare like with like. In this article, an attempt is made to sum up the main characteristics of Danish farming, to bring out some of the basic differences between it and British farming, and to help remove some of the misconceptions which have arisen about the Danish farmer and his achievements.

Nature has not endowed Denmark with any coal or minerals, so that agriculture is the most important industry, and the country must rely on agricultural products from its soil to earn the major part of its living. At the last census some 22 per cent of the population was engaged in farming, compared with a figure of about 5 per cent in Great Britain. The present characteristics of Danish agriculture can be traced back to the latter part of the nineteenth century, when world cereal prices were falling by reason of the opening up of the cereal-growing areas, notably in North America. The Danes, as a stroke of genius, realized that the prices of animal products were not falling to the same extent, so that it was good business to import cheap cereals and export the more valuable animal products. The rapidly expanding industrial population in Great Britain provided a ready market for these products.

But in adopting this as their main form of farming, the Danes did not merely turn themselves into a processing factory. They continued to grow as much as possible on their own soil, and imported feedingstuffs merely to supplement their own production. These imports were partly cereals (mainly for pigs and poultry) to supplement the barley and other corn crops which they grew themselves, and also protein-rich oilcakes (primarily for dairy cattle) to make good the deficiency of protein in their own crops.

It is of great importance to realize just how self-supporting the Danes are. On average, the total Danish harvest is roughly equivalent to some 12-14 million tons of barley. Before the war, the average imports of cereals and oilcakes were some 1.5 million tons (equal to about 10 per cent of their own production), whereas since the war the combined import has been of the order of 800,000 tons (about 5.5 per cent of home production). This post-war reduction is due partly to a succession of good harvests (though in 1954 the harvest was difficult with a poor quality yield) and partly to the reduction in the horse population in latter years, which enables land previously used to grow food for horses to be used for crops to be fed to pigs and cattle. The Danish scientist can also claim a share of the credit for the improved yields of Danish farms, as he has encouraged the farmers to use better varieties and to apply more fertilizers.

Competitive Farming There are approximately 8 million acres of agricultural land in Denmark, and with a population of just over 4 million, this gives 2 acres of land for each member of the population. By contrast, the area of agricultural land in the U.K., excluding rough grazings, is 31 million acres for a population of some 50 million, giving only two-thirds of an acre per person. Thus the U.K. is a heavy importer of food, whereas the Danes can feed their own population and produce a surplus for export. But being an exporter forces the Danes to be competitive in price with any other country in the world exporting the same commodity. In butter production, for example, the Danes must be competitive with New Zealand, despite all the climatic advantages which New Zealand enjoys.

Denmark is remarkably uniform in respect of soil, climate and topography, and apart from an area of sandy soils in Jutland, the soils are medium to heavy loams. There is no heavy clay, such as was known in England as four-horse land. The climate is favourable to plant growth, and the rainfall ranges from 30 inches in the west to 22 inches in the east. The temperature ranges from just below freezing point in February to approximately 61°F. in July. The country is generally flat, so avoiding any differences in farming due to altitude and facilitating the work of cultivation. The countryside is neat and tidy, with comparatively few trees and hedges, and every available piece of land is cropped.

Under these natural conditions, the style of farming which has evolved can be described as arable dairying, with pigs and poultry as ancillary enterprises. Only 13 per cent of the farm land is under permanent grass, the remainder being cropped on a system closely resembling the Norfolk four-course rotation, with 50 per cent cereals, 25 per cent root crops, and 25 per cent temporary grass. This national distribution of cropping is found on almost every individual farm, regardless of size. The most important cereal crop is barley, used mainly for pig feeding, and there is a large area devoted to fodder beet, which is grown primarily for the dairy herd.

The dairy cow is the backbone of Danish farming, the present number being 1½ million, out of a total cattle population of about 3 million. The Red Danish breed of cattle is of supreme importance and accounts for 68 per cent of the population. The other two breeds of importance are the Black and White Jutland (akin to the Friesian), representing 18 per cent, and the Shorthorn, representing 8 per cent. Pig production depends on the skim milk from the butter factories, and the famous Danish Landrace is almost the only breed kept. The present pig population is just over 5 million.

Family Labour with High Skill There are about 200,000 farmers in Denmark, and of these nearly half have farms of less than 25 acres, the typical Danish smallholding being about 15 acres. In the whole of Denmark, there are only 259 farms over 600 acres in extent. It follows that family labour plays an important part in the Danish economy. The most recent figures show a total of 112,800 permanent and 14,300 temporary workers, with a further 60,400 children and relatives working on farms. This gives a total paid labour force of 187,500, which is an average of less than one man per farm. Of this total, only 37,300 are non-resident workers—the group strictly comparable with the farm workers in Great Britain. The remainder are housed on the farms, and, of these, about half are under 21. The present wage for non-resident workers is about £6 a week for a 54-hour week, while resident workers over 21 get about £4 a week

plus board and lodging, with correspondingly less for workers below that age. As an industry, Danish agriculture has comparatively few workers to pay, and this, together with the age composition of the workers, means a relatively small outlay on farm wages.

The natural advantages of Denmark, combined with a high density of livestock and the generous use of fertilizers, have led to a high level of crop yields. For the major farm crops, yields are consistently higher than the average in Great Britain, but it is impossible to disentangle the effects of soil and climate on the yields in Denmark and Great Britain. There is probably no large area of land in Great Britain which is as uniform as Denmark, but on comparable farms in the Eastern Counties, yields are much nearer those of Denmark. Elsewhere, high rainfall, heavier soils, and greater altitude all combine to bring down the average. It is one of the questions which must be faced by the farmers in Britain whether, by keeping more livestock or using more fertilizers, they can counteract to some extent the advantages of climate and soil enjoyed by the Danish farmer.

The skill of the Danish farmers is most evident in the quantity and quality of their livestock products. Thus the average milk yield for all breeds for 1953-54 was 700 gallons with 4.03 per cent fat. In comparing these figures with milk yields in Britain, it must be remembered, however, that the Danish figure is virtually a breed average. The Danish Landrace pig has been subject to testing and selection for fifty years and is now a very uniform animal with a high standard of production. At the pig testing stations, the conversion rate from weaning to bacon weight is now 3.01 lb. of barley meal per lb. liveweight gain. The outstanding feature of the testing work is that the final assessment is made on the side of bacon, and this has led to the development of an animal which produces bacon of the quality demanded by the consumer. The breeding of Landrace pigs is confined to some 250 breeding centres, which submit animals for testing to one of the three official stations in the country. The breeding policy is thus under close control, and the emphasis is placed on performance rather than on appearance. Progeny testing for cattle is also undertaken, and most of the bulls now in use at the artificial insemination centres have a number of daughters under test.

Home of Farming Co-operatives Denmark has long been recognized as the home of co-operation among farmers, and co-operation has always been regarded as a means to an end and not an end in itself. It permeates the whole life of the Danish farmer, its best known application being in the marketing of farm products. Thus 90 per cent of both milk and pigs are disposed of through co-operative societies. Prices are announced weekly in advance, and farmers are well served by market intelligence in their papers. No farmer is very far from a co-operative dairy or bacon factory, so that marketing can be described as streamlined, and farmers need waste no time on the disposal of their products.

Co-operative societies are used as buying and selling agencies, for the provision of credit, for artificial insemination, and for a multitude of other functions. In addition, the farmers are highly organized, and both smallholders and medium-sized farmers have their own societies, which begin in the counties, are combined into provincial organizations, and culminate in national organizations with headquarters in Copenhagen. The medium-sized farmers' organization, together with the co-operatives, forms the Agricultural Council, whilst smallholders, having seceded from the Council, maintain an independent attitude. The Minister of Agriculture discusses future legisla-

tion with both bodies before submitting it to Parliament (Folketing), so that farmers with no special party can exert a very strong political influence.

The result is that farmers have a direct voice in almost everything which happens in the country affecting agriculture. The farmers' societies employ the advisory officers and pay a part of the cost themselves, being assisted by a Government subsidy towards salaries. The co-operative dairies were responsible for the eradication of tuberculosis and are now waging a campaign against contagious abortion and mastitis. The co-operative bacon factories have built the litter-testing stations and buy selected boars for use in country districts. The initiative in most developments comes from the farmers. In raising standards of quality or clearing up a disease, the first steps are taken voluntarily, and not until experience of a scheme has been obtained is there a demand for legislation to compel the stubborn minority to conform.

Perhaps the most outstanding feature of Danish agriculture is the complete absence of any form of subsidy, price control or price support. Nor is there any request from the farmers for assistance of this kind. The Danish farmer realizes that he must produce and sell on a world competitive market, and no country which derives 60 per cent of its export income from agriculture can afford to pay a subsidy. The question is often asked how the Danes can produce and sell at what appear to British farmers to be low prices. There is no one complete answer to this question. It is a combination of self-help among farmers, hard work, and maybe long hours, specialization, efficient animals, economical marketing, and a determination to produce goods of high quality, which in time become an advertisement in themselves. Most Danish farmers could be styled " dirty-boot " farmers, and there are few, if any, managerial costs to be met out of their surplus.

Dangers of Specialization This account of the merits of Danish farmers should not lead to the conclusion that they have no problems. There has been great prosperity in Danish agriculture in the years since the war, when the world has been short of food. With the passing of these shortages, Denmark finds that in the countries to which she sends her exports the home producers are sheltered, with a natural tendency to receive priority on their home market. Thus the imports of Danish bacon into the U.K. are limited in quantity, and sales of butter have to compete with margarine. For other markets, the possibilities of disposal show a tendency to shrink. The Danish farmer remembers the spectre of the 'thirties, when he produced himself into poverty, and fears are expressed from time to time whether another such period is about to begin.

For the moment, the immediate solution to these problems is better and cheaper production of the traditional butter, bacon and eggs. By specializing in these products, the Danes have been able to keep down their costs of production, but such a high degree of specialization has its inherent dangers and makes Denmark very vulnerable to a comparatively small change in economic conditions. The future of butter production in competition with margarine is by no means secure, and if butter prices were to fall to an uneconomic level, the dairy industry would be endangered and that, in its turn, would affect their pig production. Denmark is very dependent on the British market which, since the war, has taken 75 per cent of the butter exports and 90 per cent of the bacon exports. It is not surprising, therefore, that the Danes watch with great interest the increased productivity in British agriculture, although they feel confident that they

can always produce more cheaply and efficiently and that the problem with which they may be faced in the future is more likely to be one of disposal rather than of competitive costs of production.

Next month Mr. Ronald Ede writes about the agriculture of the Netherlands.

LAND DRAINAGE IN NORTH BUCKS

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Experience since the war on the heavy clay soils of north Bucks shows that while crops on badly-drained soils frequently do not bring in enough to repay outlay, the profits from well-drained fields can, in the course of a few years, easily cover the costs of drainage.

THE northern part of Buckinghamshire is an area of heavy land, which is either gently undulating, or which, although not absolutely flat, rises and falls only a little. There is evidence that much of the land was artificially drained many years ago, yet today many fields suffer from impeded drainage. Unfortunately, drainage work was sadly neglected for a long period before the last war, and consequently watercourses became choked with vegetation and silt, ditches were trodden in by stock, and drains were blocked. Drainage systems, which had formerly been effective, gradually ceased to function, so that more and more land became waterlogged for longer periods in wet seasons.

The ill-effects of impeded drainage crept in so insidiously that they excited little comment until the war-time ploughing-up campaign started. Drainage was then, and still is, the most potent single factor adversely influencing the growth of crops in north Bucks.

For many years before the war a high proportion of the agricultural land in the area had been permanent grass. Much of that grass has now been ploughed up, and has produced reasonable crops (mostly corn), in spite of the fact that many fields have been periodically subject to waterlogged conditions. It will be remembered that the years 1939-45 were relatively dry, and that many of the crops were grown on ploughed-up turf. Thus, superficially, the ill-effects of impeded drainage were masked. It was not until the end of 1946 that the urgent need for solving the drainage problem became manifest, for 1946 was a "wet" year—the first since 1939. Land which had for several years shown little evidence of being inadequately drained became waterlogged in the winter of 1946-47. Since then, every other year has had prolonged spells of wet weather, which have caused the periodic waterlogging of poorly-drained fields.

Survey of Fields During and since the war a lot of drainage work has been carried out in north Bucks: the channels of the principal watercourses have been cleaned of silt and vegetation, ditches have been dug out on many farms, and fields have been successfully drained. Of the three systems of draining—tile, mole, and combined mole-tile—the last has been the one most commonly used. Experience has shown that the combined mole-tile system is very effective, and is not unduly costly. In most of the

schemes carried out the *gross* cost of the draining has varied between £25 and £30 per acre, whilst in those cases where there have been exceptional circumstances it has been higher—more than £40 per acre. As the Ministry may pay a grant of up to 50 per cent of the actual cost of an approved scheme of draining, the *net* cost of such work will be substantially less than the actual gross cost, and will, in most instances, be only half as much.

To obtain evidence about the value of land drainage, a survey of fields which suffer, or have suffered, from impeded drainage, is being conducted in north Bucks. The fields are well scattered over the area, and are situated on several different clay formations—boulder clay, Oxford Clay, Ampthill Clay, Kimmeridge Clay, and gault clay. Some have been drained since 1945, whilst others are in need of drainage. The following information is being recorded about each field:

1. The condition of the field before being drained.
2. The drainage work (if any) already carried out.
3. The success or failure of the drainage work.
4. Additional drainage work (if any) necessary.
5. Cost of the work done.
6. Yields of crops grown over a period of at least five years.
7. Assessment of the value of the drainage work done.

The survey is showing that it is economic to drain land suffering from impeded drainage, provided it is supported by general good farming. When land is adequately drained, skilfully cultivated, and suitably manured, it will produce good crops. At present prices, a good crop when sold will yield a surplus over the cost of production, and it is obvious that the cost of any normal drainage work can be met out of the surplus resulting from the growing of several consecutive good crops. The survey is also drawing attention to the financial loss which can be incurred in a wet year on poorly-drained, heavy land, when the cost of growing an arable crop may be much more than the selling price of the produce.

Poor Drainage is Expensive Included in the survey are three fields (let me call them "A", "B", and "C"), which are in a sorry plight as a result of impeded drainage. They are examples of the ruinous losses, both of crop and money, which may occur when heavy land is waterlogged. Field A, of about 12 acres, was taken over by the present occupier in February 1951. He could not then sow a spring crop as the soil was waterlogged for weeks on end, and so he had to bare fallow the field. Autumn wheat was subsequently drilled: it yielded 2 qr. per acre. Both in the autumn of 1952 and in the following spring, the field was so wet that it could not be cultivated, and so it had to be fallowed once more. Wheat which was planted in autumn 1953 was severely harmed by the wet conditions which prevailed during the winter. The financial loss incurred on this field is substantial. Only two crops of corn, both poor, have been produced in four years.

Field B comprises 40 acres, with a slight fall to one ditch, but with several saucer-shaped depressions in the middle. Drainage is badly impeded. Since 1945 the field has cropped very indifferently. For instance, since 1951, when it was fallowed, it has produced a bad crop of autumn wheat (8½ cwt. per acre) in 1952, and a poorish crop of spring barley (14 cwt. per acre) in 1953.

Field C provides further evidence of the harm caused by bad drainage, for during the past five years it has yielded one useful crop of hay and three bad crops of wheat.

Fields A, B, and C have been mentioned because the dismal record of the pitiable crops they have produced compels one to notice the financial loss likely to be met when poorly-drained, heavy land is cropped. As part of the survey as much information as possible has been recorded about the crops grown on a number of fields. Details of the cultivations carried out, the manures used, the seed drilled, the operations at harvest, and so on, have been collected. By charging up the various items at costs assumed as being likely to have been incurred by local farmers, using their own labour and machinery, it has thus been possible to make a rough estimate of the cost of growing each crop. The following table shows the estimated cost of growing a crop on Fields A, B, and C, and the estimated returns achieved.

Estimated Costs and Returns per Acre of Wheat Grown on Poorly-drained Heavy Land

	Field A	Field B	Field C
Size	12 acres	40 acres	10 acres
Crop	Wheat (Autumn)	Wheat (Autumn)	Wheat (Spring)
Yield of corn harvested (per acre)	9 cwt.	8 cwt.	7 cwt.
COSTS	£ s. d.	£ s. d.	£ s. d.
Cultivations to prepare seedbed	7 10 0	3 11 0	3 0 0
Seed	2 16 0	2 16 0	3 7 6
Manures (at sowing)	—	1 16 0	1 16 0
Operations at drilling time	11 0	15 0	18 6
Manures (nitrogenous spring top dressing)	1 7 0	1 10 0	—
Cultivations, weed spraying, etc., subsequent to drilling	3 0	4 7 6	—
Harvesting and handling crop afterwards	2 15 0	2 15 0	2 15 0
	15 2 0	17 10 6	11 17 0
Rent	1 10 0	1 10 0	1 10 0
Overheads	3 0 0	3 10 0	2 7 6
Total Estimated Cost of Growing Crop	19 12 0	22 10 6	15 14 6
RETURNS			
Suggested value of corn harvested	13 10 0	12 0 0	10 10 0
Loss	6 2 0	10 10 6	5 4 6

Although the various items quoted in the table are only rough estimates, they are good enough to show up the poor financial returns from heavy land which is waterlogged in wet seasons.

Good Drainage Repays its Costs The drainage survey also indicates that heavy land, when suitably drained, will produce good crops. For instance, three fields, (let us call them "X", "Y", and "Z") are good examples of the benefits brought about by drainage. Field X, which is on boulder clay, had the reputation of being a poor, wet field, growing up to half a crop of wheat in a dry year, and no crop at all in a wet year. In 1950 it was drained at a *gross* cost of £40 per acre, and then fallowed. Since then, it has produced three consecutive barley crops, all of which have been of good quality. The 1951 crop yielded 6 qr. per acre; the 1952 crop, 4 qr.; and the 1953 crop, 7 qr. per acre. The improved crops cannot be attributed wholly to the draining, because since 1951 the field has received outstandingly good cultivations and liberal manuring.

Nevertheless, but for the drainage work, the crops could not have benefited from the improved standard of cultivating and manuring.

Field Y, a field on Oxford Clay, grew poor crops of corn during and after the war. For instance, in 1951 when the field was managed in two equal areas, one half sown with winter oats yielded about 2 qr. per acre, and the other half, sown with spring oats, produced about 5 qr. per acre. In 1952 the field was drained at a *gross* cost of £29 per acre, and then fallowed. Wheat was drilled in the autumn, and gave a yield of 6 qr. per acre. Cultivations were good, but the manuring could, with advantage, have been more liberal, so that an even better crop might have been obtained.

Field Z, which is on boulder clay, was drained in late 1950, and since then has consistently grown good crops. Previously, crop yields had been very erratic—a satisfactory crop in a dry year, and a poor yield, or even no crop at all, in a wet year. Now that the field has been drained, the farmer can be reasonably certain of sowing a crop every year and of getting satisfactory yields.

Rough estimates of growing a crop in 1952-53 on each of Fields X, Y, and Z have been worked out and compared with the value of the corn harvested. In each case there is a profit—in sharp contrast to the crops on the poorly-drained land. A general impression of the financial results attained by the crops on the drained fields X, Y, and Z can be obtained from the following table:

Estimated Costs and Returns per Acre of Crops Grown on Recently-drained Heavy Land

	Field X	Field Y	Field Z
Size	30 acres	37 acres	20 acres
Crop	Barley (Winter)	Wheat (Autumn)	Barley (Spring)
Yield of corn harvested (per acre)	30 cwt.	27 cwt.	23 cwt.
COSTS	£ s. d.	£ s. d.	£ s. d.
Cultivations to prepare seedbed	3 18 0	2 17 0	2 14 0
Seed	2 16 0	2 16 0	3 7 6
Manures (at sowing)	1 16 0	—	2 14 0
Operations at drilling time	12 6	11 0	17 6
Manures (nitrogenous spring top dressing)	1 16 0	—	1 10 0
Cultivations, weed spraying, etc., subsequent to drilling	2 1 0	7 0	2 1 0
Harvesting and handling crop afterwards	3 15 0	6 2 6	3 5 0
	16 14 6	12 13 6	16 9 0
Rent	1 10 0	1 10 0	1 10 0
Overheads	3 7 0	2 10 0	3 4 0
Total Estimated Cost of Growing Crop	21 11 6	16 13 6	21 3 0
RETURNS			
Suggested value of corn harvested	40 0 0	40 10 0	30 0 0
Surplus	18 8 6	23 16 6	8 17 0
Gross cost of drainage (combined mole-tile system)	£40 per acre	£29 per acre	£23 10 0 per acre
Net cost of drainage to the farmer	£20 per acre	£14 10 0 per acre	£11 15 0 per acre

These figures suggest that the value of the crop on each of the drained fields has been big enough to give a profit over the cost of production, part of which will contribute towards the cost of the drainage work. It is admitted that the costs of producing the crops in the foregoing tables are again based on rough estimates, and so must be accepted with a good deal of reserve; nevertheless, they do point unmistakably to the improved financial returns which can be yielded by crops grown on drained land, as compared with those given by crops on waterlogged fields.

The cost of draining the heavy land in north Bucks is so high that it can only be justified by good crops. Thus when land has been drained it must also be skilfully managed—in particular, well-chosen and thorough cultivations, and adequate manuring. It must not be overlooked that if drained land is treated in a negligent manner it may crop no better than if it were undrained. There is no doubt, however, that the drainage of heavy land, if effectively carried out, can be very profitable to the farmer.

WOAD

J. C. WALLACE

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"All the Britons dye themselves with woad (*vitrum*), which makes them a sky-blue colour and more terrible to their enemies." So wrote Julius Caesar 2,000 years ago. Today most of us think of woad as something used only by the ancient Britons, but, in fact, it was cultivated in this country to a limited extent as recently as thirty years ago.

IF as some writers suggest, woad was cultivated by the ancient Britons, it qualifies as being one of the earliest cultivated plants in this country. But it also grew wild, and it seems probable that the wild crop was sufficient to meet the requirements of those ancient people. Be that as it may, woad was certainly cultivated in this country from the Middle Ages to the early years of the present century, and its production for the dyeing of woollen cloth was a flourishing, if limited, industry as late as the latter half of the eighteenth and first half of the nineteenth centuries. Arthur Young, in his *Report on Lincolnshire Agriculture*, presented to the Board of Agriculture in 1790, records that some farmers in the Fens grew up to 200 acres of woad every year. But the introduction of indigo dye struck a blow at the woad industry, although woad was still used for a long time for the dyeing of Government cloth, and, in conjunction with indigo, to fix the latter dye and bring out a better colour. When indigo dye was first introduced, farmers called it "the Devil's dye". They protested to the Government against its use, but without avail.

By 1890 there were only four woad growers in the whole country, one of whom was still growing 50 acres annually, and by the early years of the present century the number of growers was down to two. The last woad

to be grown commercially in this country was about five acres in a field on the outskirts of Boston in 1924. The following year this field grew sugar beet. Thus one of the oldest crops was followed by the newest.

Dyers' Woad (*Isatis tinctoria*)* may be found wild in several localities and is usually considered a native of this country. According to Bentham and Hooker, however, it is "repeatedly found in several localities in Britain, but scarcely fully naturalized, except near Tewkesbury, where indeed it appears to be indigenous". Yet it was growing in these islands 2,000 years ago.

Fenland Crop The woad plant is a biennial, producing in the first year a cluster of longish, narrow leaves (in this stage the crop looks rather like a field of young spinach), and throwing up a flowering stem, with a cluster of small yellow flowers, in the second year. It was the first year's leaves which were used for the manufacture of the dye. Woad requires a rich soil, and was generally grown on ploughed-up grassland. Three and, on the very best land, four crops could be grown in succession, after which cereals were taken for a few years before the land was again sown down to grass.

The woad industry, at its peak, was concentrated chiefly on the alluvial soils of the Fen country, where conditions seem to have been particularly suited to it, but it was also grown in Yorkshire and Somerset.† The number of growers was rather small, for the grower also prepared the woad for the dyer, an operation requiring skill, experience and a fair amount of capital for the erection of the mill and machinery. The woad had to be grown within reasonable horse-haulage distance of the mill, and a considerable acreage was required to keep the mill going. It was the custom for the grower to hire suitable grassland for three or four years from local farmers. But available grassland in the vicinity was very soon used up, and it therefore became the practice to erect only a temporary building of timber and thatch to house the machinery, and to move to a new area every ten or twelve years. Suitable land commanded a high rental—£7 per acre a year was quite usual, and up to £10 per acre was often paid for the best land. There are records of good woad-growing land being sold for as much as £150-200 per acre. It is said that the land benefited greatly from the growing of woad, for very good crops of oats and wheat were obtained afterwards. It is recorded that in 1851 six quarters of wheat per acre were commonplace on woad land. Meager (1697), recommending the growing of woad to improve the soil, said, "it prepares the ground very well for corn, and good Estates have been gotten by it".

The grassland was ploughed in the early winter, and the woad seed sown at intervals from the middle of March to the middle of May. The first sowing was gathered at the beginning of July. A second harvest, and on the best land, a third, could be obtained from the earlier sowings, but produced second-quality dye. The land was ploughed in the autumn ready for sowing again the following year. The leaves were twisted off by hand when the plants were about eight inches high, and put into baskets for transport to the mill, care being taken to keep them free from soil.

* Dyers' Woad should not be confused with Dyers' Weld or Would (*Resedu luteola*), which was grown for its yellow dye.

† Leonard Meager, writing in 1697, said, "the best natural parts of this Kingdom for woad are parts of Worcestershire, Warwick, Northampton, Gloucester, Leicester and Buckinghamshire."

Processing for the Dye On arrival at the mill, the leaves were fed into the grinding, or, more accurately, the pulping mill. This consisted of three large wooden wheels, 3 feet wide, 7 feet in diameter on the outer side, and 6 feet on the inner side, with projecting iron bars fitted on their circumference every 4 inches. They revolved on a granite floor, and were driven on a central axis linked by shafting to an outside capstan worked by eight horses, which were changed twice, or sometimes three times, a day.

Under these large wheels the leaves were crushed to a pulp, which was thrown into an adjoining room and there pressed by hand into balls about the size of a small football. These balls were then placed on tiers of open-work racks, roofed over to keep off the wet. When dry, the balls were removed to a store, where they remained until the winter.

When the cutting season was finished, the balls of woad were taken back to the mill, and this time the woad was ground to a fine powder. The powder was then spread in a layer about three feet deep on the floor of an adjoining room, moistened with water, and turned daily with shovels, water being added as required to keep the mass in a proper state of fermentation. This required great skill to get the woad to "beaver" well—a term used to define the fineness of the capillary filaments into which the woad draws out when broken between the fingers. When the fermentation was complete, the woad was cooled, packed in casks, and sent off to the factories. The process of fermentation was known as "couching".

During the fermentation period, the smell from the woad was very unpleasant, and old woad workers have told me that their wives would not allow them into the house until they had changed and washed in an outhouse.

In the Boston area a few permanent buildings of brick were put up to house the machinery. One of these still stands, and is used as a village hall. Another at Brothertoft, of which no trace now remains, was apparently very large and well organized. The owner had 1,300 acres of land, and grew 200 acres of woad every year. The land was interspersed by small canals or waterways, and the large crates in which the harvested woad was placed were moved by barge to the mill. The crates were then raised by crane to the first floor of the mill, and the woad leaves fed down shutes to the pulping wheels. The balls of pulp were placed in large trays which were taken on trolleys to the drying racks. Subsequently, these trays were hoisted by the cranes to the first floor and the balls fed down the shutes again to be ground to powder. This building was the first permanent woad mill to be erected. The other brick buildings put up in the Boston area were much smaller and simpler than the one at Brothertoft.

Profitable Industry Woad growing appears to have been a fairly profitable industry. A rent of from £7-10 an acre or a purchase price of £150 an acre were high figures for those early days, and, indeed, are comparable with prices paid today in the Fenland for good land for the growing of daffodils and tulips. In a normal season a yield of 1½-2 tons per acre of prepared woad could be expected, and £25 a ton was quoted as the average price of good quality woad. Labour costs were low—at the end of the eighteenth century male farm workers at Boston were paid 10*s.* a week in winter, 12*s.* in summer and 30*s.* during the harvest. Around Spalding, the equivalent wages were 10*s.* 6*d.*, 15*s.* and 42*s.* The gathering of the woad leaves into baskets or crates was done mainly by women, who would be paid a lower rate than the men. The building to house the mill was usually

simple and cheap, and the amount of wear and tear on the machinery was small.

At the beginning of the present century, the few crops still being grown were by arrangement with the cloth manufacturers, the price being fixed in advance. The following figures are for a crop grown near Boston in 1920:

	per acre £	*s.*	*d.*
PAYMENTS			
Preparation of the land	5	5	0
Labour of sowing, hoeing, cropping, cartage of leaves, and couching*	49	3	0
Cost of manure (artificial)	7	9	6
Carriage of casks of woad to market	4	0	0
Rent of land, rates and tithe	6	10	0
	72	7	6
RECEIPTS			
By sale of 3 tons of woad @ £40 per ton	120	0	0
	72	7	6
Profit	47	12	6

* Couching was the term applied to the process of wetting, turning and fermenting of the woad, but in this statement it obviously includes the pulping, balling and drying.

The high yield of 3 tons per acre may be accounted for by better methods of preparing the land, and, more particularly, by the use of fertilizers. A figure of £40 a ton is not high in comparison with the £25 paid at the beginning of the nineteenth century, although in 1890 woad was sold for as little as £9 a ton.

Woad was only one of a number of small rural industries, such as weld and madder growing, which succumbed to new methods in the nineteenth century. It is said that cloth dyed with woad would retain its true colour for a lifetime. But who today would wish to wear the same suit or dress for a lifetime?

THE CATTLE OF BRITAIN

20. WELSH BLACK

THE Welsh Black—the native cattle of Wales—is still the predominant breed in many parts of the Principality, especially in Merioneth, north Cardiganshire, and parts of Caernarvonshire and Denbighshire. These cattle are among the oldest in Great Britain, being the descendants of the cattle which the ancient Britons took with them to their mountain fastnesses as they retreated from the invading Saxons. Bred on the mountainside in exposed areas for hundreds of years, they have inherited a toughness which makes them well known for their hardiness and thriftiness. This characteristic, combined with the ability to produce under good conditions 700-1,000 gallons of milk at over 4 per cent butter fat and to finish as a top quality butchers' beast, is something that every Welshman can be proud of.

The reason why the Welsh Blacks are not as well advertised as some other British breeds is that the Welsh-speaking hill farmer has little inclination or chance to push his cattle beyond his immediate neighbourhood. Nevertheless, the merits of the breed have been appreciated outside Wales for many years. Thus Youatt in 1838 wrote of the breed:

> Great Britain does not afford a more useful animal. . . . They combine to a considerable degree, and as far perhaps as they can be combined, the two opposite qualities of being very fair milkers with a propensity to fatten. The meat is generally beautiful marbled. It is equal to that of the Scotch cattle, and some epicures prefer it. They thrive in every situation. They will live where others starve, and they will rapidly outstrip most others when they have plenty of good pasture. . . . Great numbers of them are brought to the London market. They stand their journey well and find a ready sale, for they rarely disappoint the butcher, but on the contrary, prove better than appearance and touch indicate.

This description still holds good today, and it is the policy of the Welsh Black Cattle Society to enhance these very qualities.

Despite its ancient lineage, it was not until 1874 that any active steps were taken to improve and establish the breed. In that year a Breed Society was formed and the first volume of the Herd Book was published. At that time there was a marked difference between the types of Black cattle to be found in North and South Wales, probably due to the lack of communication between the two areas. The North Wales type was a compact, sturdy animal adapted to the mountain conditions, while the South Wales strain, which was also known as the "Castlemartin", was a much bigger animal, although, like the North Wales type, it was well known for producing butter and beef. It was because of this difference that the North Wales breeders issued a separate Herd Book in 1883, and two separate volumes were in fact published annually until 1904, when the present Society was formed. Since then, the aim has been to intermingle these two strains, and it is interesting to note that the most successful exhibitors in the main shows in recent years have been those who have succeeded in doing just this.

Milk recording is a comparatively recent innovation amongst breeders of Welsh Blacks, but it is interesting to know that selection of bulls on Welsh farms in bygone days was made by keeping a bull calf from the best butter-producing cow, and by so doing breeding a strain of cattle capable of producing good quality milk. Since milk recording has become widely practised among breeders of Welsh Blacks, herd averages of 700-800 gallons and over 4 per cent butter fat have been attained. One of the difficulties of milk recording in Wales is the fact that on most farms the milking capacity of a cow cannot be fully expressed because of the adverse climate and poor fodder. On the hill farms the dairy cows have to graze the poorer upland pastures during the summer months to allow the better land to grow winter food. Cows which have given between 500 and 700 gallons under such conditions are known to have added considerably to their lactation yield when moved to good land.

To improve the breed, the Society has recently introduced another standard to the Register of Merit, known as the "Advanced Register". Not only must a cow give 800 gallons of milk at 4.2 per cent butter fat in her third or subsequent lactation, but she must also pass an inspection for type and conformation as a true dual-purpose animal. The number of cows reaching this standard is increasing, and it is hoped that buyers of Welsh Black bulls in the future will give preference to those from dams so registered. Although the Society does not encourage yields over 1,000 gallons, Welsh Blacks frequently do exceed this figure.

The Welsh Black cow seldom calves down with a flush of milk, as does her counterpart in many of the dairy breeds, but gives a steady yield throughout the lactation, and consequently maintains her condition over the whole year. Many a Welsh Black heifer giving less than 3 gallons a day when she calves will give between 600 and 700 gallons in her lactation, and will calve again within twelve months. A Welsh Black cow is considered at her best at 10-14 years of age, and many cows between 15 and 20 years old continue to give profitable yields. Due to their longevity, freedom from diseases and the capacity to consume and transform rough herbage into milk and beef, they can rightly be regarded one of the most economical of the British breeds.

Since its milk yield has not been over-emphasized, this hardy, dual-purpose breed has retained its ability to produce a carcass which carries a large percentage of lean meat of excellent flavour on the best cuts. It has been said that the Welsh Blacks are slower than some other beef breeds in coming to maturity, but there is little evidence to support this contention, and when Welsh Black calves have been reared under the same conditions as competitive breeds, there has been very little, if any, difference in the date of maturity. With their general healthiness, hardiness and freedom from disease, the Welsh Blacks are a joy to their owners. Combining as they do so many admirable qualities, they merit a far wider recognition than they have so far achieved. They are, in fact, a " three-in-one " breed with ability to produce what is wanted today—milk, beef and butter fat.

G. Williams Edwards,
Secretary,
Welsh Black Cattle Society

FARMING AFFAIRS

Sir James Scott Watson: An Appreciation The retirement of Sir James Scott Watson at the end of the year from his post of Chief Scientific Adviser and Director-General of the N.A.A.S. will mark only the close of yet another phase in a long career, which has been throughout wholly devoted to the betterment of agriculture. It is rare for one man, so fully dedicated to the service of his fellow men and seeking no personal aggrandizement, to achieve distinction in so many diverse fields as those which Scott Watson has enriched with his native ability, industry and enthusiasm.

To his many pupils, he will always remain the University teacher, wise and scholarly; to the agricultural scientist, a man of encyclopedic knowledge and shrewd judgment; to the farmers, a trusted adviser and friend; to a wide general public, a writer, lecturer and broadcaster, with a happy knack of making the most difficult subjects seem easy; and to his colleagues in the Ministry, a devoted Public Servant subjugating his personal desire to spend his life in the field and the laboratory, in order that he might place his vast knowledge and great understanding of British farming at the service of his country.

How great is Scott Watson's knowledge of British agriculture can be known only to those who have had the good fortune to work with him. To

travel with him is an experience in itself. First, he will read through a pile of papers with deceptive speed; it is very unwise to assume that he has not absorbed everything that matters, however quickly he may flick over the pages. Next, by way of relaxation, he solves *The Times* crossword, and then he looks out of the carriage window at the passing fields, which are his real love. He knows the whole countryside so intimately that almost at once he picks out something of interest in the passing landscape; a farm where the owner is successfully grading up a herd of Friesians, or an area of unexpectedly light land with a southern slope where early potatoes are being grown. Perhaps it is not surprising that he has this uncanny knowledge, since for so many years the whole of Great Britain has been his farm.

Scott Watson does not like Committees, he regards each as just another task that has to be done. Like everything else, however, to which he puts his hand, he is thorough and painstaking in his preparation; he is not one of those who can attend with unread papers and be content to try to pick up enough during the meeting to join in the discussion. He speaks seldom and when he does it is often with a little preface, disclaiming any special knowledge of the subject, followed by a thoughtful contribution to the discussion, which discloses an unexpectedly close and detailed understanding of the subject. These little prefaces are the only "dishonesty" of which Scott Watson can ever be accused, and they are not in truth dishonest because his modesty makes him underrate himself and overrate the ability of others.

A distinguished former pupil said of Scott Watson: "His only fault is that he hates hurting anyone." Many of us would be glad to have Jim Scott Watson's major fault counted as our outstanding virtue. We wish him every happiness and success in the next phase of his career.

Sir William Slater, K.B.E., D.Sc.

Farming Cameo: 48. North-west Durham This is a land of vivid contrasts, lying between Wear, Derwent, and Tyne, and bounded on the west by the Pennines. It is traversed from west to east by deep glaciated valleys, and the contours vary sharply from 300 feet to over 1,000 feet above sea level. Amongst these valleys, the struggle between farming and coal mining has been prolonged and bitter, and nowhere has the farmer emerged from the struggle more successfully.

In the middle of the district around Stanley and Burnopfield, the coal seams come very near to the surface, and hundreds of acres are devastated by craters and water-filled pitfalls. Damage by colliery subsidence is here accepted as another farming hazard, and many devastated acres have been bulldozed and laboriously reclaimed. A long-established mixed farming system is now built around a strict five- or six-course rotation. Corn and potatoes are cheerfully grown at 1,000 feet, and the acreage of potatoes is surprisingly high to meet the demands of the mining community. Extensive opencast mining adds yet another burden to tortured agriculture, and the tireless jaws of the draglines frequently dig coal literally under the farmer's bedroom window. On certain sites, even farmhouse and steading have been sacrificed to King Coal.

Looking westwards, however, the scene changes. The huge ironworks at Consett dominate the countryside from their lofty seat and represent the last bastion of industry, as green pastures run up to the very foot of the mountainous slag tip. The county boundary here runs along the south bank of the picturesque Derwent and then stretches a greedy finger to the rooftop of the Pennines. Undulating moorland rises to over 2,000 feet at the

head of Weardale, and cold, biting winds sweep unhindered eastwards from Crossfell and Kilhope Law. This wild stretch of country was once the hunting domain of the Prince Bishops of Durham, and the ecclesiastical authorities still own huge tracts of this unenclosed moorland, as well as many of the surrounding farms. The farmers have common grazing rights on these fells, which are either "stinted" or unrestricted.

It is a hard country, populated by a breed of men resigned to isolation and famed for their spartan qualities and sense of humour. The local flora is predominantly nardus with stunted heather, and on this type of grazing the hardy and widely-foraging Swaledale reigns supreme. Rigorous shepherding is necessary on these unfenced and shelterless moors, but the going is sound and stock are relatively free from nutritional and parasitic diseases. Dairy farming still holds an important place on the small farms at the fell edge, and the Galloway bull is used extensively on the indigenous Shorthorn cow to produce store cattle. The Blue-faced Leicester, a near relative of the Border Leicester, is bred around Hexham in the nearby Tyne Valley. From Swaledale ewe and Blue-faced Leicester tup is bred the Müle—a speckled-faced beauty renowned for its fattening and mothering propensities.

A little to the south on a high ridge above Weardale stands the bleak mining town of Tow Law, which contains a small but popular auction mart. It is here that lowland and fell farmers meet, and the same graziers and feeders return every year to buy from the same breeders. Tow Law stock will carry forever as their brand, "T" for thriftiness and "L" for £ *s. d.*, as they "do" exceptionally well on the kindlier farms of south Durham and north Yorkshire.

North-west Durham is a land of extremes and can, therefore, only be described by what may at first appear to be an excessive use of superlatives. It is true to say, however, that one of the highest main roads in England passes through it, that it contains some of the wildest country in the north, and that all classes of farming are successfully performed at the highest altitudes, and often under such adverse conditions as are met with nowhere else in the country. Little wonder, then, that the north-west Durham farmer is so successful and well respected when he chooses to farm elsewhere than in the district in which he was bred.

G. Ross,
District Advisory Officer

The Mechanic on the Farm: 9. Soldering

The art of soldering is well worth acquiring, for much time can be wasted in trying to join two pieces of metal together in other ways. Some workers would rather go to the trouble of drilling holes and using nuts and bolts than tackle a job of soldering. And pieces of wire or binder twine are often used where a few minutes spent in soldering would make a really firm job. In maintenance, as well as in repairs, soldering has many uses. For example, the cleaning and coating of rust spots on tinned dairyware prolongs the usefulness of the equipment, while the soldering of open seams in milk utensils and the smoothing of corners and rough spots with solder makes cleaning easier and helps to keep down the bacteria.

The only essentials for the job are a good iron, a few sticks of tinman's solder and some flux. The technique is not really difficult. The head of the soldering iron (which is made of copper and not iron at all) should weigh about 1 lb. Irons heavier than this are tiring to use, and a smaller one does not hold enough heat to finish a reasonable job.

The iron can be heated in a coke or coal fire, but this is not the best way. It is difficult to know when to withdraw the iron to test the tempera-

ture, so the iron often gets overheated, and soot and sulphur deposit from the fire are difficult to clean off. A pressure paraffin stove is more convenient for heating, but it must be working with a clear blue flame, otherwise the iron becomes sticky and unusable. If the workshop has electricity, an electric soldering iron is well worth buying. One with a bit weighing 1 lb. and consuming 125 watts is about the right size for general work.

For most soldering jobs, a fluid containing chloride of zinc is the best flux to use. Very good proprietary fluxes of this sort can be bought ready prepared, but one can easily be made in the workshop by dissolving granulated zinc in hydrochloric acid and adding a little salammoniac to the chloride of zinc. The preparation is called "killed spirits", because the zinc has killed the activity of the hydrochloric acid. One drawback of killed spirits is that it becomes acid again when used as a flux. Thus it is not suitable when the joint being soldered cannot be easily and completely cleaned, for the acid will slowly work on the metal and corrode it. In such cases it is better to use one of the resin fluxes. Powdered resin will serve, but proprietary fluxes, in which the resin is in paste form, are much more convenient.

For successful work, a soldering iron must have a coating of solder over the tip. This is called the tinning. To achieve it, the iron should first be heated and the point rubbed on a rag. The rag will scorch, but this will not matter; the soot and scale and other corrosion will have been removed from the surface of the soldering iron. The tip of the soldering iron should then be plunged into flux, quickly removed, and rubbed into some solder held in a flat tin. The solder in contact with the iron will melt and, if the iron is twisted and turned in it, the molten solder will adhere to the iron in a thin coat. The iron must be retinned whenever the coating of solder on it becomes dull or dirty. This smooth, tinned surface is essential, because the heat in the iron cannot be transmitted to the work if there is an insulating film or scale of carbon between.

Cleaning of the work before soldering must be very thorough. Solder will stick to clean metal, but will not adhere to any trace of rubber insulation, paint or grease. The pieces to be soldered must be scraped or filed until they are clean. If emery paper or sand paper has been used for the cleaning, the surface must be washed with water before the flux is put on, since the material used to hold the emery or sand on the paper leaves a powdery deposit which spoils the flow of solder. Failure of solder to take is generally due to one or more of four things: the job is still dirty; the flux has not been properly applied; the iron is not really hot; or the iron had not been allowed to remain in one place long enough to heat the work.

When two flanges of metal are to be soldered together, it is best to begin by coating each flange. Provided the tinning is complete, the surfaces can then be easily and strongly united by heat.

Plumbing jobs are best done with a blow-lamp. Pressure paraffin blow-lamps are not expensive to buy and find so many uses on the farm that it is worth while to buy a good, large one. The paraffin container should have a capacity of at least a pint.

H. J. Hine

New Legislation to Control Rabbits The Pests Act, 1954, which provides for the more effective control of wild rabbits and for ending the use of gin traps after July 31, 1958, received the Royal Assent in November. Under Part I of the Act, rabbit clearance areas may be set up in which it will be the duty of occupiers to keep their land

free from rabbits. A start will normally be made with areas of about 10,000-20,000 acres, in which rabbit control should present no special problem; for example, districts in which myxomatosis has taken a heavy toll and which are bounded by rivers or other barriers to reinfestation. The areas will be selected by County Agricultural Executive Committees, in consultation with representatives of farmers, landowners, forestry interests and agricultural workers. Notice of a proposal to make a clearance order will be given to persons interested and time will be allowed for objections to be lodged.

It will generally be to the occupier's advantage for his land to be included in a clearance area, since he will be assured that his neighbours are taking steps to clear rabbits at the same time as he is. He may use any legitimate means, such as trapping, gassing, the use of long nets, etc.; but where it is necessary to shoot and the occupier does not have full shooting rights, he must obtain the consent of the owner of the shoot before bringing on more guns than the Ground Game Act allows him to do. The owner may elect to shoot the rabbits himself, instead of allowing the occupier to do so, but if he does nothing about it the occupier may ask the County Committee to authorize him to bring on additional people to shoot the rabbits.

Grants of up to half the cost are available for clearing rabbit harbourage such as scrub, for demolishing warrens and for the erection of rabbit-proof fencing, but, for the time being, payment will normally be limited to land included in rabbit clearance areas. The occupier may be required by order to undertake work of this kind if it is essential for controlling rabbits. Here again, an opportunity will be given for lodging objection to the proposal. There are penalties for failure to comply with the requirements of a clearance order, and Committees may enter and destroy rabbits if the occupier defaults in his obligation.

Part II of the Act deals with trapping. It will be an offence to use a gin or other unauthorised trap after July 31, 1958; and it is hoped that by then the Humane Traps Advisory Committee will have developed and arranged for the provision of an adequate supply of effective humane traps. Should this not materialize, the date may be postponed, with the approval of Parliament, for a year at a time; but the Order must be laid at least two years before the date it postpones. The date can also be put forward a year if the Committee find they are ahead of schedule; but here again at least two years' notice of the earlier date must be given. As an incentive to trap designers, it is proposed to offer monetary awards in respect of humane traps that come into general use.

Power is also given to the Minister to authorize the use of approved traps for catching rabbits on open land, but this will not be used until suitable traps have been approved. Designers who wish to work on traps to catch rabbits in the run and which will be relatively harmless to birds and domestic animals, should apply to the Ministry for an experimental licence.

Whenever outbreaks of myxomatosis occur, some rabbits may be expected to survive, and the Myxomatosis Advisory Committee has recommended that every advantage should be taken of the unique opportunity offered by the disease to eliminate the survivors before they build up their numbers again. Provided farmers, landowners, woodland owners, agricultural workers and countrymen generally prosecute a vigorous and co-ordinated campaign against the surviving rabbits, the new powers to establish rabbit clearance areas should ensure that lasting benefit is secured. The Government, has, however, made it clear that myxomatosis is not the complete

answer to the rabbit problem; and further that it is opposed to the deliberate spreading of the disease. To emphasize this view, the Act makes it an offence to use an infected rabbit to spread the disease to uninfected rabbits.

Preventing Disease on the Farm Every year, despite past achievements and the unceasing efforts of our research workers, disease continues to take an all too heavy toll of Britain's farm-stock. Such losses not only increase the overall cost of production, but frequently also wipe out the lifetime's work of a breeder. It is therefore essential that this battle against disease should be vigorously fought in both laboratory and field.

Now to recognize fully the problems that remain to be solved in this field, there must first be an understanding of what has already been achieved in the elimination and control of disease in our herds and flocks. A comprehensive account of our progress to date is therefore of value not only to the research worker but to the stock owner, who has an equally important part to play in this common struggle.

Such an account was, in fact, given in four of the papers read at the meeting of the British Association for the Advancement of Science at their meeting at Liverpool in September 1953. These papers have been gathered together and published under the title *Prevention of Disease among Farm Livestock*.*

This, surely, is a booklet no one interested in the health of our farms can afford to overlook.

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* Obtainable from any Sale Office of H.M. Stationery Office, by post from P.O. Box 569, London, S.E.1, or through any bookseller, price 1*s.* 3*d.* (1*s.* 4½*d.* by post).

BOOK REVIEWS

Woodland Management. W. E. HILEY. Faber. 63*s.*

Written in four parts and dealing thoroughly with the organization of a woodland department, the felling of timber and conversion of woodland products, woodland maintenance, and, lastly, woodland administration, this is one of the most comprehensive and authoritative books on the subject available today. In many ways it is also, as the author points out in the preface, a tribute to that remarkable institution, Dartington Hall, where he received much encouragement and help.

Mr. Hiley supports the case for afforestation with moderation and appeal; he has some words to say about the availability of land for forestry. Once the establishment of a forest unit has been decided upon, he demonstrates the need for organizing its management along practical lines, and lays before the reader in carefully arranged and well-written chapters all the wisdom of his twenty years of practical experience. How many acres of woodland are run to no particular plan at all, and how many of those concerned with the management of woodland could, unaided by advice, draw up a management plan which would satisfy the criteria of being good forestry and good finance?

Although primarily intended for the bigger man, there is much to interest the small woodland owner in this book, and, indeed, he gets a chapter to himself at the end. The value to an individual farm of only a small wood is often high in terms of timber and shelter; and the establishment of a shelter-belt is, in approved cases and as one item in a comprehensive scheme, likely to attract a grant under the Livestock Rearing Act, 1951, in upland areas where the Act applies.

R.G.A.L.

Poultry Farming for a Living. CYRIL GRANGE. Macmillan. 10*s.* 6*d.*

In these days of specialization in the field of agriculture it must be very difficult for a newcomer to make up his mind concerning the advisability of entering any one of the many branches which exist. Curiously enough, although poultry-keeping became a specialized job earlier than most, in more recent years there has been an increasing tendency for it to return within the ambit of general farming.

Mr. Cyril Grange's new book, *Poultry Farming for a Living*, is clearly intended to be read by those who are at the crossroads. The field which he covers is very broad, and although some of the ideas which he puts forward may be rather out of date, the book is full of sound common sense.

I believe that we shall be seeing a return of the specialist in poultry in the next ten years, particularly in table poultry production, and therefore I would have liked to have read a little concerning the mass production methods of poultry-keeping which are being practised in other parts of the world and are already in existence here. It would have been an admirable opportunity to point out the pitfalls to the newcomer. I would also have liked to have found an allusion to the close influences that climate and geography have on intensive poultry-keeping. Deep litter and, to less extent, henyards for laying birds, have come to stay. I think the new entrant ought to know that henyards can only be worked satisfactorily in the warmer and drier parts of the British Isles, and that the construction of, and the technique for running, deep-litter houses varies materially with their location.

However, there is so much sound advice about the basic principles of poultry-keeping in this book—for instance, a strong warning against overcrowding—and so many practical suggestions which seem to me to be so necessary for the newcomer, that it will, I feel sure, be read with great benefit by many who are looking for their future living to poultry-keeping.

H.R.F.

Breeding Better Livestock. V. A. RICE, F. N. ANDREWS and E. J. WARWICK. McGraw-Hill. 34*s.*

An excellent account, not only of the established practices but also of the newer movements which are now taking place in livestock breeding in the U.S.A., is contained in this new publication. The book is divided into four distinct parts. Section I deals with the general background of animal breeding from domestication to modern methods and the growing importance of the breeding industry, and Section II considers reproductive efficiency. Many essential facts in the latter section are shown in table form: for example, it is clearly brought out that in pigs 10-15 per cent of the sows do not conceive each year, and that of the eggs shed by fertile sows only 27 per cent are alive at weaning. On the use of A.I., the authors remark that it will allow more sires to be proved, as well as more proved sires to be used. Section III deals with the mechanisms of heredity, genes and chromosomes. It explains the Mendelian laws of inheritance and contains lists of lethal genetic characters in farm animals. Section IV discusses questions of inbreeding, outcrossing, cross-breeding and selection.

This last section also contains many worthwhile tables showing the results of recent American research work on animal husbandry. Reference is made to the production of new breeds of cattle for hot climates and of new breeds of pigs with more suitable carcass qualities, arising from crosses with the Danish Landrace. The results of crossing inbred lines of pigs and of three-way crosses on increasing production of fertility, milk and meat are tabulated. There are some valuable data for converting twice-a-day to three-times-a-day milking and for estimating 365-day output from 305-day records.

Some useful advice is given on the matter of selection. Select your young bull, say the authors, from a herd which has used three proven sires in succession, and choose good cow families in such a herd. The importance of weaning weight in beef cattle is emphasized and figures are given of the percentage hereditability of this and other characters. It is also interesting to read that the practice of selling calves off the cow at weaning for slaughter, in the same way as with fat lamb, is now increasing in some areas of the U.S.A. Lists are given of performance records which should be kept for the different classes of livestock if selection is to be based on commercial qualities.

The authors conclude that, in the light of recent scientific findings, not 50 but 75 per cent of the breeding for commercial qualities goes down the animal's throat. In other words, three-quarters of success in breeding depends on the breeder himself, through his system of feeding and management, and only one-quarter on the animals involved.

J.H.

BOOK REVIEWS

Farmer and Stock-Breeder Year Book, 1955. 10*s.* 6*d.*

Of all the aids to the practising farmer, this year book is widely known as a reference book *par excellence*. As usual, it contains some first-rate articles on important topics of the moment—headed, this year, by Professor H. G. Sanders (" Planning for Free Markets ") and Professor M. M. Cooper (" Keeping Milk Profitable "). It has all the long-established features—Mr. George Wardrop's discussion on the year's crop of new machinery, 70 pages of photographs of show champions, and a detailed reference section.

It can be said without qualification that the *Farmer and Stock-Breeder Year Book* is an extremely desirable piece of farming equipment—more appositely described, perhaps, as a veritable agricultural " Baedeker ".

L.W.T.

Rothamsted Experimental Station Report for 1953. 7*s.* 6*d.*

Research on soils and crops has been going on at Rothamsted for more than a hundred years, and during the whole of this time the scope of the work undertaken has steadily increased. Since the war, too, there has been a rapid expansion in research facilities at the Station, and the number of staff there is now double what it was ten years ago. The setting up of the N.A.A.S., with its widespread regional field experimentation under different soil and climatic conditions, has also added to the range of Rothamsted's research by the many collaborative investigations that have been undertaken. There are, in fact, a number of references in the present account to outstation work of this kind.

The detailed reports from the thirteen specialist departments of the Station, which form the basis of the annual report, are preceded by an admirable introduction which summarizes the main lines on which work proceeded in the laboratory and on the farms of Rothamsted and the Woburn Experimental Station. Though much of the work is academic in character, it is clear that its bearing on practical farming problems is continuously borne in mind. Other investigations of a less fundamental type are aimed at providing direct answers to the problems of farming which inevitably arise with changes in farm practice and agricultural policy.

Many facts and conclusions of interest to farmers and growers occur throughout the Report. It is obviously not possible to mention them all here, but among the more noteworthy are the identification of a mineral which appears to be responsible for the fixation of potash in the soil; the fact that root nodule development in legumes seems to depend more on the susceptibility of the root to infection by root nodule organisms than on the population of nodule bacteria surrounding it, indicating that plant breeders might do well to search for strains of legumes, such as clover, which freely produce nitrogen-fixing nodules; and the suggestion that fields infested with the *A. fatua* species of wild oat are likely to do better under winter corn than spring corn. The Report also points out the need for a National Compound fertilizer having a high rate of nitrogen and potash to phosphorus, and suggests that greater use might be made on acid soils of ground mineral phosphate, at a third of the cost of superphosphate, especially for swedes and established grassland in wetter districts. A widespread survey of rabbit damage indicated that yields of grain on winter wheat fields were reduced by 1½ cwt. per acre throughout the country in 1952. It is pleasing, too, to learn that work on the control of Wheat Bulb fly is being intensified.

The Report also includes three interesting special reviews, on bees as pollinators, on the physical properties and contact toxicity of insecticides, and on recent work on molybdenum in plant nutrition.

Copies of this publication may be obtained from the Librarian of the Rothamsted Experimental Station, Harpenden, Herts.

A.J.L.L.

Young Farmers in Denmark. NANCY MARTIN. Macmillan. 7*s.*

Ten boys and girls from the Gaythorne Young Farmers' Club visit Møn, a small island in the south-eastern corner of Denmark. How they earn the money for the journey, the interesting places they visit en route, including Hans Andersen's birthplace at Ødense, and the many things they learn about Danish farming during their stay is told in a well-written and quickly moving story. The authoress has gathered her material at first hand in Denmark, and the farming information and descriptions of Danish life are authentic. There are some pleasant illustrations and, as a frontispiece, a good pictorial map of Denmark. The book should appeal to young people from 10 to 14 years of age, especially if they have already made the acquaintance of the members of the Club in *Young Farmers at Gaythorne*, by the same writer.

M.C.B.

BOOK REVIEWS

Intermediate Botany (4th Edition). L. J. F. BRIMBLE. Revised and rewritten in collaboration with S. WILLIAMS and G. BOND. Macmillan. 20*s*.

This text-book, first published in 1936, has now reached its fourth edition, so it may be assumed that it has established a place for itself as one of the "standard" text-books of botany. The general arrangement of this edition remains essentially the same as that of the previous one. New subject-matter has been added, where this has been made necessary by the progress of the botanical sciences, and parts of the text have been revised and rewritten. The appendix of questions and answers has been omitted, whilst the suggestions for practical work at the end of each chapter have been revised and extended. New or improved illustrations add to the attractiveness of the edition, which has a more sumptuous appearance than its predecessors.

Young students are apt to look upon a text-book as something in the nature of a bible, and it is debatable whether the shattering of their faith in its accuracy should be regarded as an inevitable step in their education. But one feels that, in a text-book such as this, experience gained with previous editions, as well as in other publications, should have ensured a relatively high standard of accuracy. It is disappointing, therefore, to find several erroneous or misleading statements likely to bewilder the more discerning student. For example, the plants producing the fruits from which the dried currant, raisin, sultana and muscatel are made are said to be "closely related to the grape vine (*Vitis*)"; the Ginkgoales are classified as tropical plants, without any mention of the fact that the one surviving monotypic genus grows under temperate conditions and is hardy in this country; *Larix decidua* and *Taxodium distichum* are stated to be the only two deciduous coniferous trees. These and similar errors are for the most part only of minor importance so far as the student's syllabus is concerned, but such authoritative misinformation detracts from the academic value of what is otherwise a readable, well-illustrated, and attractively produced book. It is intended to satisfy the needs of candidates for the G.C.E. (advanced level) and first-year University examinations, but its readable style and profuse illustrations suggest that it may also provide useful further reading for intelligent younger students.

S.G.H.

Journal of the Edinburgh Agricultural Former Students' Association. No. 29. November 1954.

There is much to be said for the collegiate journal as a link between Alma Mater and the old student. There is even more to be said for it when, as in the case of Edinburgh, nostalgia is blended with a practical utility. In this particular issue of their annual publication, for example, we range from a discussion of local farming problems and an account of the work of a home research station (Rowett), to agriculture in Iceland, impressions of a flying trip down the "spine" of Africa, and a description of a native irrigation scheme in Southern Rhodesia. There is, too, a most thoughtful and thought-provoking article by Professor M. M. Cooper on the prospects for British agriculture.

For non-members, copies of the *Journal* are obtainable from the Hon. Editor, Edinburgh Agricultural Former Students' Association, 13 George Square, Edinburgh 8, price 2*s*. 2*d*. (including postage).

L.W.T.

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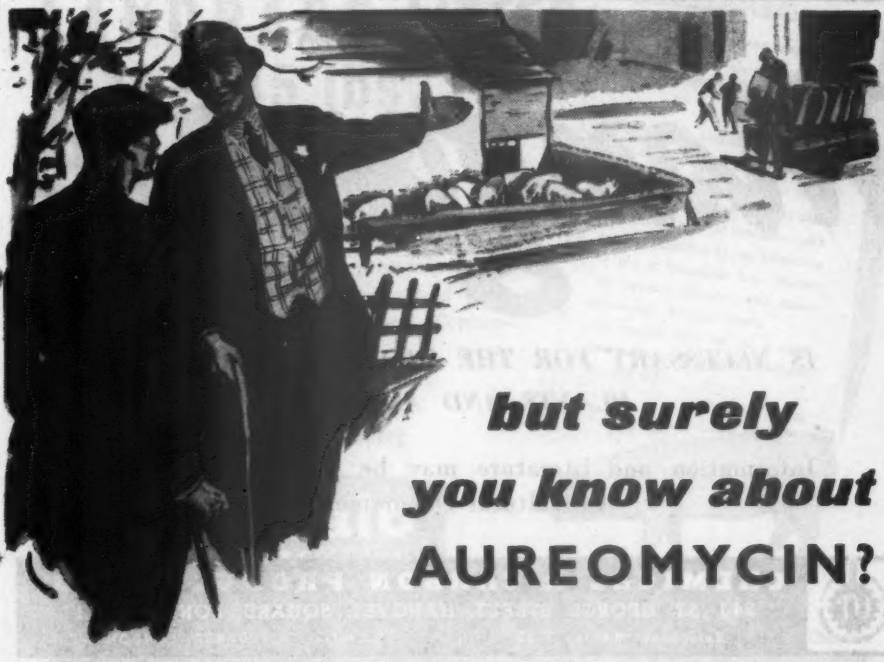

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